THE DENTAL PRACTITIONER

AND DENTAL RECORD

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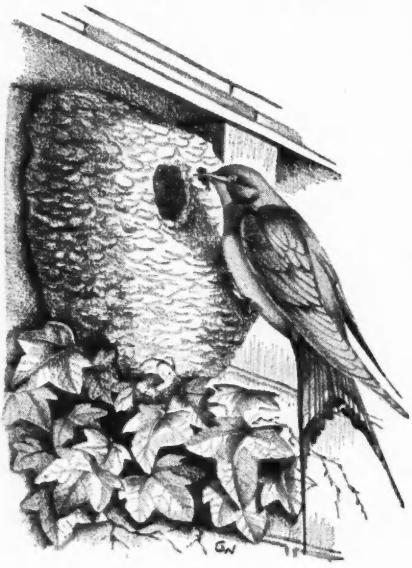

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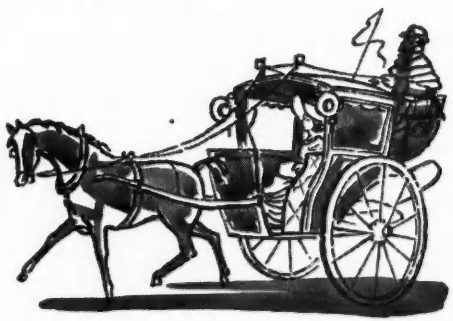

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THE DENTAL PRACTITIONER AND DENTAL RECORD

Vol. X, No. 8 April, 1960

EDITORIAL

THE HEALTH OF THE PROFESSION

THE pace of modern dental practice produces a mental, physical, and nervous exhaustion which is probably not found in any other profession to the same degree. It must prove, in the long run, deleterious to the health of the professional man and the profession as a whole. Some measure of the stress involved may be indicated by the fact that the suicide rate in the dental profession is one of the highest among the various occupations in Great Britain, as also is death from cardiac failure of neurological origin.

Why should this be? Is it because the dentist takes on more work than he can accomplish in fairness to his conscience, himself, and his patients?

The public demand for treatment in this country is so great that the comparatively few dentists are overwhelmed. The maintaining of the normal routine treatment required fills the appointment book to overcrowding, without taking into consideration the emergencies, of which every practice has its quota. The heartless can send them away, but there are few who cannot fail to honour their obligation to their fellow men.

Why should the mental and nervous strain be greater than in other walks of life?

Where else does one find this exhaustion of operating on the conscious patient, of carrying out delicate procedures on men, women, and children who are in a highly nervous state—where a slip or error of judgement can cause anxiety, distress, and possible pain to both the patient and the operator. And in what other profession do you find men and women trained to perform certain services to the public, controlled in the decisions they must make with regard to the provision of those services?

All this undoubtedly contributes to the dentist's nervous and physical tension. But there is another important factor. *The dentist is a professional person.*

Yet through taxation and the presently-in-force scale of remuneration he is hard put to maintain a standard of living commensurate with the professional standing of the other professions in the community. Even in the Welfare State he still wishes to control his own status. And why not? This individuality and independence is every individual's birthright. But the sacrifices he must make to retain them take a heavy toll in worry.

What is the answer? Much of it must come from the powers that be. A more realistic understanding of the dentist's problems. A more realistic approach to remuneration of the profession in relation to these problems. The early provision of many more new dental schools to provide a greater number of fully qualified dentists. A more realistic approach to the taxation and super-taxation of the professional man. Above all, a recognition that the dentist is an integral factor in the maintenance of the health of the nation.

Serve him well and he will serve the public well.

THE SURGICAL TREATMENT OF SOME OF THE LESS COMMON ABNORMALITIES OF THE FACIAL SKELETON*

By J. H. HOVELL, F.D.S., L.D.S., M.R.C.S., L.R.C.P.
University of London

In discussing the surgical correction of variations of the facial skeletal pattern, the types of case one meets fall into two main categories. The following is the classification I use for these variations:—

1. Variations of normal type but excessive degree:—

a. Skeletal Class III.

b. Skeletal Class II: (i) Superior protrusion; (ii) Inferior retrusion.

2. Variations of abnormal type:—

a. Prenatally determined growth dysplasias.

Maxillary: (i) Cleft palate; (ii) Underdevelopment of the maxillary complex; (iii) Oxycephaly and similar conditions.

Mandibular or Combined Mandibular and Maxillary Agenesis: (i) First arch dysplasia; (ii) Intra-uterine damage to condylar growth centre.

b. Natally or post-natally determined growth dysplasias: (i) Maxillary; (ii) Mandibular.

The first class falls, in my opinion, entirely into the specialty of oral surgery, and a great deal of work on aetiology, diagnosis, and treatment has been carried out, mostly by oral surgeons. As a result, we have now a number of established basic principles to guide us in deciding when to operate and what type of operation to perform in each individual case.

The same cannot be said of the second class —for two main reasons.

First, these conditions are rare and the opportunity for study and treatment by any one individual of more than a few cases is very limited. Secondly, they fall into the borderline between plastic and oral surgery. To many plastic surgeons they are an interesting and unusual occurrence—a challenge only to his technical skill—and the dental surgeon is merely called in as another technician to provide splints for fixation of bones in new positions after operation or to carry out moulds for epithelial inlays.

At St. Thomas's my plastic colleague, Mr. R. V. Battle, is most co-operative. Our decisions as to treatment are made as a result of a joint assessment of the case which is then treated by either or both of us, according to the surgical procedures entailed.

As a result I have been able to follow up and assess the results of treatment in relation to the aetiology of a few of the conditions. Various facts have emerged which have led me to formulate certain principles which should be adhered to in treatment planning.

Let us consider first one of the commoner disorders of growth, mandibular underdevelopment of excessive degree. This excludes normal variation, such as the relatively small mandible which may be found in some malocclusions of the Angle Class II type.

For purposes of treatment planning mandibular agenesis falls into two main aetiological groups.

1. A localized growth disturbance at one or both condylar growth centres.

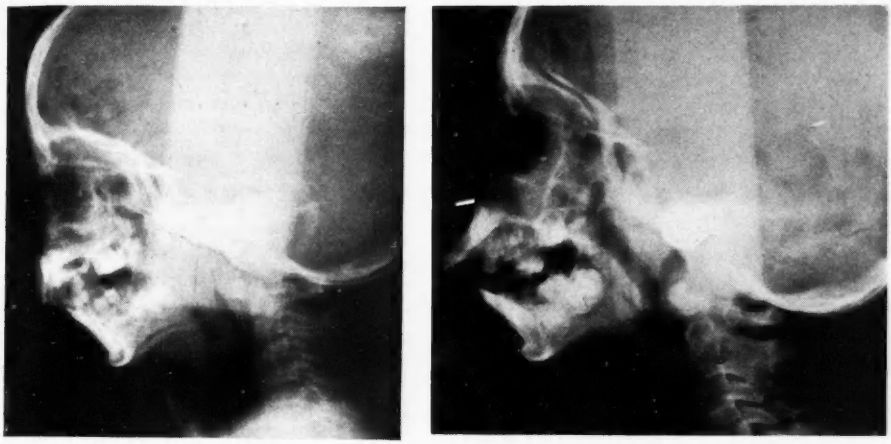
This may be due to various causes, either ante-natal or post-natal. The child may be born with an underdeveloped mandible, either unilateral or bilateral, which may be associated with limitation of movement or complete ankylosis of one or both temporomandibular joints.

In such cases the deformity is primarily in the mandible itself. There are later secondary changes in the glenoid fossæ and associated musculature, and also in maxillary development. These latter structures, however, are potentially normal. It is only the restricting

* A paper read to the Odonto-chirurgical Society of Scotland on March 13, 1959.

effect of the underdeveloped mandible which has produced changes in their growth pattern and development. This is a most important consideration in treatment planning.

Because the environment is normal, normal moulding processes continue and an attempt



A B

Fig. 1.—Mandibular agenesis due to birth trauma. A, X-ray of mandible in child aged 4 years; B, Same child aged 9 years. Note changes in shape of the mandible and position and inclinations of the teeth.

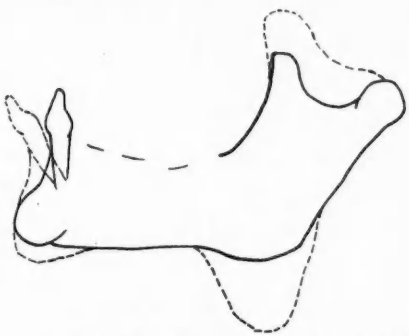


Fig. 2.—Tracings from *Fig.* 1 to show how the growth of muscular processes produces the shape of the mandible, typical of condylar growth dysplasia.

is made to produce normal muscular attachments upon the shortened jaw. This produces a mandible of quite typical shape.

Fig. 1 shows first such a mandible in a child aged 4 years. Note the slight notching of the lower border and the lower incisors slightly proclined to the mandibular plane. The coronoidal process is continuous with the condyle and there is no sigmoid notch.

The next picture shows the same child aged 9 years. It can be seen how the notching of the lower border has increased. Normal tongue growth has increased the proclination of the lower incisors and the dento-alveolar structures have moved forward relative to the body of the mandible.

Fig. 2 is a tracing showing how growth of muscular processes and forward movement of dento-alveolar structures produce the typical mandible of condylar undergrowth. When a mandible of this shape is found it is absolutely diagnostic of a localized condylar growth disturbance. The same shape of jaw is seen in postnatal reduction of condylar growth due to trauma or infection. In the prenatal cases the growth of the coronoid process usually completely eliminates the sigmoid notch so that condyle and coronoid form one continuous bony mass.

2. The second type of prenatally determined mandibular agenesis is merely part of a wider syndrome—first arch dysplasia (Mackenzie, 1958). Again the cause is not definitely known. It has been suggested, however, that an early

occlusion of the embryonic stapedial artery (which supplies the first arch) may be the cause.

Any, or all, of the structures arising from the first arch may be affected. The degree of

Fig. 3.—X-ray showing outlined shape of mandible in a case of first arch dysplasia.

agenesis varies from complete absence to the slightest abnormality—little more than a normal variation. Also the various structures arising from the first arch are by no means always affected to the same degree.

With regard to the shape of the mandible itself, certain features distinguish this clearly from a condylar growth dysplasia.

The mandibular environment is itself abnormal. There is weakness of the muscles supplied by both 5th and 7th nerves in this area, due probably to underdevelopment of the muscles themselves and not of central nervous origin. Normal attempts at moulding upon the shortened mandible do not therefore occur, and there is no exaggeration of the muscular processes. The bone is therefore slender and frail with a reduced angle and coronoid process. No notching of the lower border is therefore apparent in the majority of cases (*Fig.* 3).

It has already been pointed out that various elements derived from the first arch are not affected to an equal degree. When the musculature and soft-tissue environment is less affected than actual bony growth some notching may be present. This is never, however, so severe as in a pure condylar growth dysplasia.

In the differential diagnosis underdevelopment of other structures must be taken into consideration. These are notably the ear, external auditory meatus, maxilla, and facial musculature.

TREATMENT

When growth has ceased, any attempt to lengthen completely to normal the underdeveloped mandible is doomed to failure. This holds good whatever the cause of the underdevelopment. The associated abnormalities of occlusion, maxillary development, and soft-tissue environment, whether primary or secondary, render it mechanically impossible to construct a normal mandible.

The idea therefore arose that serial bone grafting to the mandible should be undertaken at intervals during the growth period. Thus a bone of normal length would be maintained during growth. This would then encourage normal development of the associated structures. Mowlem was, I believe, the originator of this idea. At first, cases were treated indiscriminately. The results were variable. In some cases permanent increase in mandibular length was obtained. In other cases the graft resorbed and the mandible returned to exactly the same length as if no operation had been undertaken.

An analysis of results—admittedly not many—led me to the following conclusions.

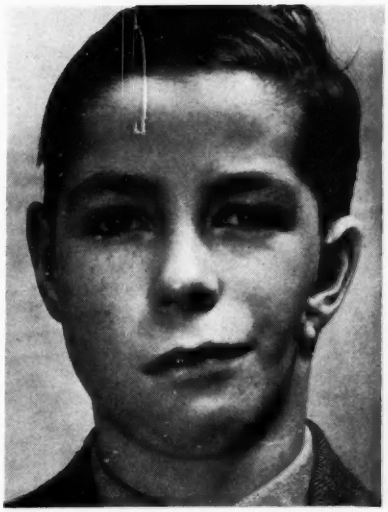
1. Cases of condylar dysplasia with no primary associated maxillary or environmental undergrowth: In such cases the results were good, with permanent mandibular lengthening.

2. Cases of first arch dysplasia with equal underdevelopment of other structures, including soft-tissue environment: These gave the most disappointing results, often with complete relapse to the original condition.

3. In between these two categories were cases of first arch dysplasia, in which some notching of the lower border of the mandible was present. This indicates an increased underdevelopment of the mandible relative to its soft-tissue environment. I gained the impression that some degree of improvement was obtainable in these cases. This may well have been wishful thinking in an attempt to fit cases into the views on aetiology and prognosis I was forming. No lateral cephalometric radiographs were available, and clinical assessment, especially of minor changes of skeletal pattern, is very unreliable.

It would, however, appear reasonable that if my views on the causes for the widely different shapes of the mandible are accepted, then my opinions upon the prognosis for serial bone-grafting in these cases should be correct. Post-operative results appear to confirm this opinion. Grafts inserted for cases of first arch dysplasia have entirely resorbed, with complete relapse to the pre-operative skeletal pattern (*Fig.* 4). This has been found to be the case not only in grafts to lengthen the mandible during the growth period, but also in onlay grafts inserted to build out bony points and improve contour after completion of growth. In one case, not only did bone onlays completely disappear, but fat grafts also were resorbed.

In contrast to this is a case of lipodystrophy involving the distribution of the 5th nerve.



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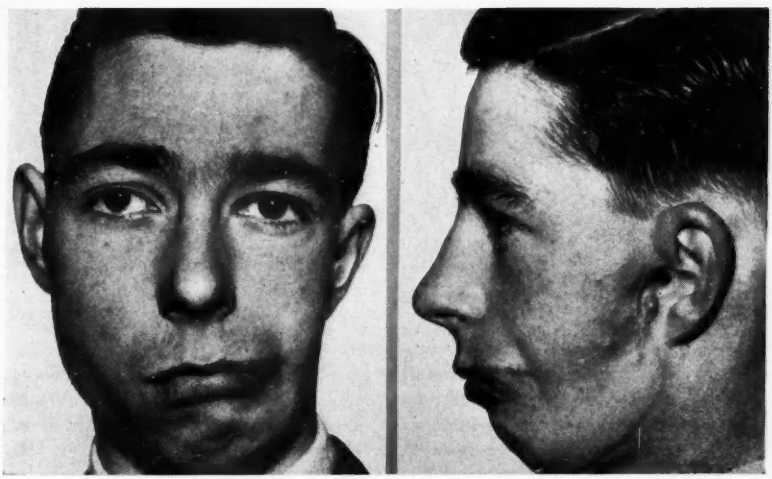

B

Fig. 4.—Photograph of first arch dysplasia. A, Aged 12 years; B, Aged 21 years. There is no improvement in spite of numerous bone and fat grafting operations.

Not only was there a complete absence of fat over this area, but also a considerable lack of development of the underlying facial bones. The skin, on the other hand, was lax and years, had apparently stopped growing. Pre-operative and immediately post-operative photographs and radiographs are shown (*Fig.* 5).

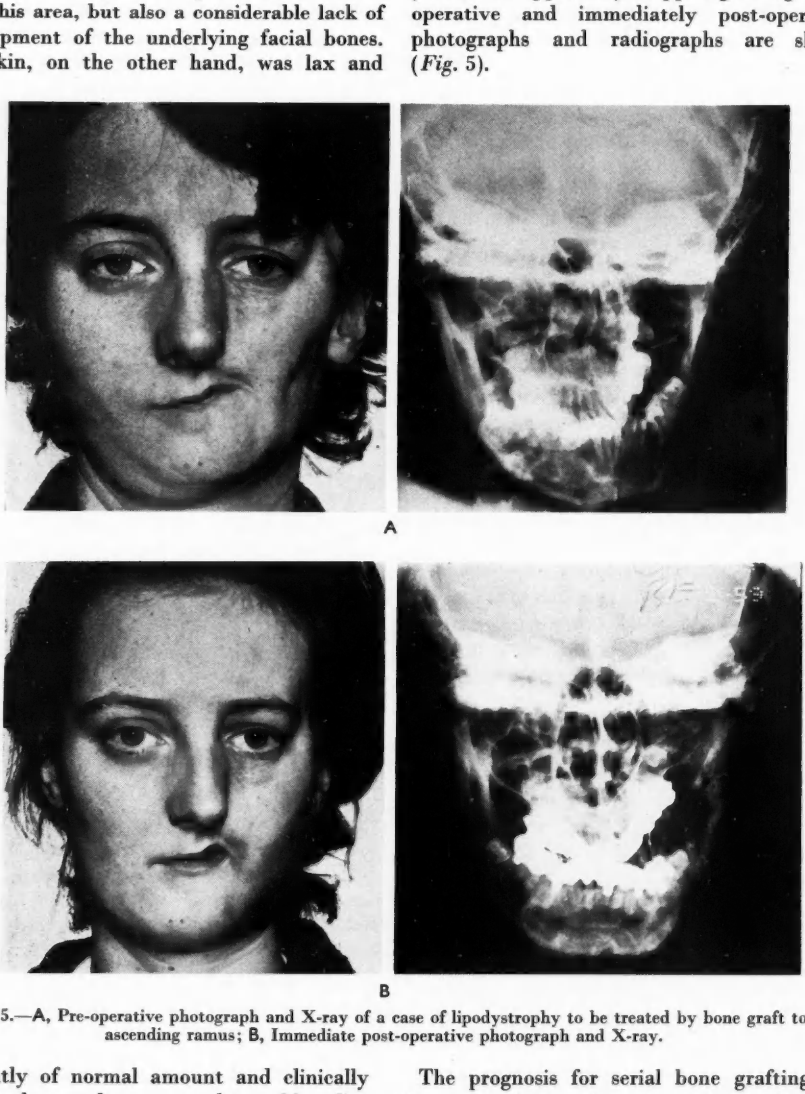

Fig. 5.—A, Pre-operative photograph and X-ray of a case of lipodystrophy to be treated by bone graft to ascending ramus; B, Immediate post-operative photograph and X-ray.

apparently of normal amount and clinically no muscular weakness was detectable. Fat grafts inserted were not resorbed, and it was decided, therefore, to attempt to correct the skeletal deformity by bone grafting, which was carried out by Mr. Battle and myself in January, 1959. The patient, a girl aged 15

The prognosis for serial bone grafting in these cases is therefore assessed according to the degree of associated agenesis of the soft-tissue environment of the bone. This is determined partly by clinical observation and partly by the shape of the bone. Prominent muscular attachments and notching of the lower border

indicate a normal environment, or at least one which is less underdeveloped than the bone itself. When the environment is absolutely normal I consider the prognosis for serial bone grafting to be one hundred per cent good. When, however, the soft tissues are affected equally with the bone, as is the case in many first arch dysplasias, I consider bone grafting to be a useless procedure, and it is inevitably followed by relapse to the original skeletal pattern when carried out during the growth period.

TREATMENT PLANNING

1. Ankylosis.—When ankylosis, either partial or complete, is present, this is the first problem to receive attention. We believe that this should be treated as early as possible for the following reasons:—

a. In order to obtain normal mastication. This is important both to ensure an adequate diet and to enable the child to lead a normal social life.

b. To prevent irreversible disuse atrophy of the muscles of mastication.

c. To enable the mandible to move forward. When the ankylosis is relieved the lower jaw, even though the growth is nil, is frequently positioned forward into better relationship with the upper by the musculature.

d. To facilitate normal oral hygiene and caries control.

With partial ankylosis, growth at a reduced level may be present, and in these cases correction of ankylosis is delayed until six months to one year before the first bone grafting operation.

With complete ankylosis in which serial radiographs have indicated mandibular growth to be minimal or nil, operation is carried out at 6 years of age.

In our unit, this operation is primarily the responsibility of the plastic surgeon. The approach is difficult. The bone, even at this age, is dense and difficult to remove. If, after freeing the worse side, mobility is still inadequate, it is absolutely essential to proceed straight away with mobilization of the opposite joint. The importance of the immediate post-operative care cannot be overstressed. The endotracheal tube must be left in situ until complete consciousness is regained. After this, the child must be specialled by a nurse capable of dealing with respiratory obstruction until one is clinically satisfied that all danger of this is past.

The ever-present danger of recurrence of the ankylosis must be reduced to a minimum. Fixation is absolutely contra-indicated. We put our patients on to chewing-gum and like to see the jaw at work the first day post-operatively.

2. Bone-grafting.—This is carried out either three times or twice during the growth period. That is to say at 8, 12, and 16 or at 10 and 15 years of age approximately. Earlier than 8 years autogenous bone-grafting is virtually impossible as there is no site available in the body for sufficient bone. So far we have not tried homogenous quick-dried frozen bone.

The operation itself is carried out either as a combined operation or by the oral surgeon. All the pre-operative planning and post-operative care, both of which are highly important, are entirely the responsibility of the oral surgeon.

The first step in treatment planning is to mount study models upon an articulator constructed from face bow readings to the patient's own measurements. This articulator has an adjustable arm or arms so that the lower model can be placed in the desired relationship with the upper (*Fig.* 6). The picture shows an articulator constructed for a unilateral case. It is seen that lengthening of the ascending ramus separates the cheek teeth on the affected side. If it is also necessary to swing the jaw across to correct the centre line, it is often found that interference from incisor teeth and canines prevents complete correction. In such cases, prior orthodontic treatment to eliminate this interference is undertaken. It is only necessary to do such treatment as will permit correct positioning. An effort to move other teeth into better positions is a waste of time—they do it by themselves post-operatively.

When any necessary preliminary treatment has been completed upper and lower cast silver cap splints, with hooks for wires, are

constructed. These are placed upon the models, articulated as before upon a special articulator, and corrected to the desired amount both with respect to swing and to

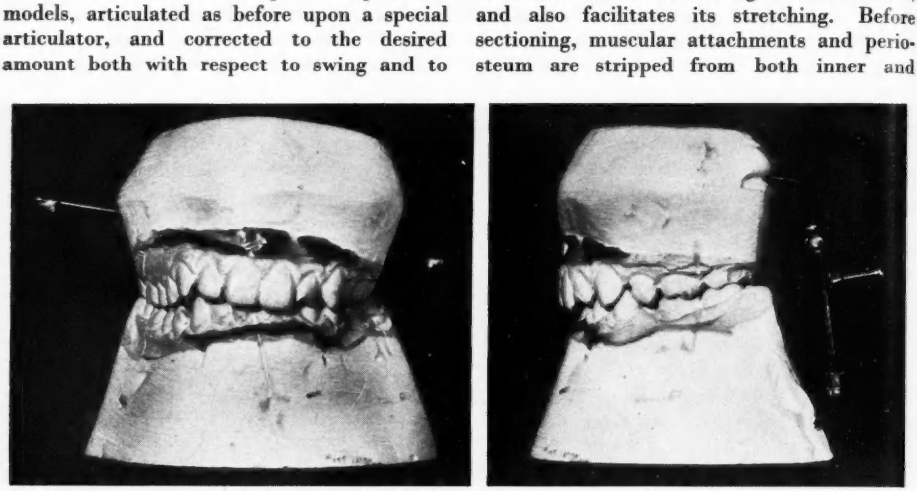

Fig. 6.—Articulator constructed for pre-operative treatment planning in grafting of the ascending ramus.

opening of the bite on the affected side. An acrylic block is then constructed to fill the gap between upper and lower where the bite is opened. This is put in position after operation and permits firm intermaxillary fixation in the predetermined position. Being a pessimist I always construct a couple of blocks in partially corrected positions, but so far have not needed to use them.

At the same time an acrylic plate is made to another upper model. This caps the cheek teeth on the affected side and is built up in a block on the articulator, to fill the interocclusal gap to be created.

OPERATION

The ascending ramus is approached from an incision parallel with and just behind its posterior border, extending up to just below the lobe of the ear and downwards about ½ in. beyond it. The ramus is usually too short to be divided above the mandibular foramen. It is desirable to avoid division of the neurovascular bundle. The outer wall of the mandibular canal is therefore removed and the neurovascular bundle mobilized from the mandibular foramen forward to the body of the mandible. This enables the ascending ramus to be sectioned leaving the nerve intact, and also facilitates its stretching. Before sectioning, muscular attachments and periosteum are stripped from both inner and outer surfaces of the ramus along the line of section.

A tooth germ is usually found in the line of section and removed. Drill holes are made for subsequent wiring of the graft.

The jaw is divided with a saw (I use a nasal refracture saw) and the fragments mobilized to obtain maximum separation.

At this stage a dirty assistant undertakes the intermaxillary fixation with the acrylic block in the predetermined position.

Bone is obtained from a rib, or in the older patients from the iliac crest. In obtaining bone from the iliac crest the epiphysial cartilage can be elevated and the bone removed from below it without dividing it.

In older patients the outer surface of the ramus is decorticated adjacent to the line of section, but this is unnecessary in younger patients, the amount of outer plate removed in exposure of the neurovascular bundle being adequate.

Cancellous bone (if obtainable) is packed between the bone ends and the remainder of the graft wired on to the outer surface of the ramus as an onlay (*Fig.* 7).

The wound is closed in layers without drainage.

POST-OPERATIVE MANAGEMENT

Complete immobilization is maintained for at least 10 weeks. At this time, if clinical union is present, the splints are removed and the prefabricated upper plate inserted and adjusted to the bite. This is worn unchanged for 6 weeks to allow further consolidation of the graft. After this it is cut away entirely from the occlusal surface of the most distal maxillary tooth, i.e., the first or second molar. The upper and lower teeth thus cleared then erupt into occlusal contact over a period of 2–3 months. When they are in occlusion other teeth are cleared, and so on until the plate can ultimately be discarded.

The planning and treatment of bilateral cases is entirely similar. It must be remembered that in advancing the lower arch to normal position (1) it should be slightly overcorrected from the point of view of incisor relationship, as the lower incisors are always overproclined; (2) the posterior teeth must always be separated to allow increased height of ascending ramus. The amount of separation not being governed by the other side as in unilateral cases must be estimated. The method of estimation I use is to make a tracing from a lateral radiograph of the facial bones. I then make a separate tracing of the mandible, which I cut out. This cut-out mandibular silhouette I then place in the estimated correct position on the tracing, and thereby assess the amount of posterior opening needed.

Serial bone-grafting of this nature not only produces a good æsthetic result without need for epithelial inlays and prosthesis, but also provides a mandibular basal bone capable of carrying a fairly normal full denture, should this ever become necessary. I consider it has a very definite place in maxillo-facial surgery.

The second growth abnormality with which I shall deal is condylar hyperplasia. This presents in two main forms. The first is a sudden spurt in growth of one condylar growth centre at the age of puberty in girls. Normally at this age mandibular growth has slowed down very considerably. As a result there is increasing asymmetry of the mandible, with swing of the centre line of the chin to the opposite side. Later the lower border of the jaw loses its slight upward convexity and becomes bowed downwards. The growth potential of the dento-alveolar structures may

Fig. 7.—X-ray of onlay graft in position.

be exceeded, in which case the cheek teeth on the affected side move down out of occlusion. Occasionally there is pain in the opposite temporomandibular joint.

The affected condyle is larger than normal and on histological section shows excessive active growth. The condylar neck is elongated and often curved or twisted.

The second type of case, much rarer, is a sudden recommencement of condylar growth in an adult—again I have only met this in a female.

Fig. 8 shows a woman, aged 40 years, who stated that she first noticed her jaw becoming asymmetrical ten years previously. When seen, active growth was still continuing. Correction of this was not easy. First a resection of head and neck of condyle was undertaken. The neck of the condyle was about three times normal length and spiral in form. After exposing the condyle and freeing its ligamentous attachments via the normal

route, it was necessary to make a second incision below the level of the facial nerve in order to divide the neck at its junction with the body. A year later when the occlusion had settled the bowed lower border was trimmed via a submandibular incision.

The difficulties met in correcting this case convinced me that the correct procedure is to prevent progress to such an extreme condition. As a result I now observe these cases until I assess from measurements and lateral radiographs that the amount of bony overgrowth is equivalent in amount to the amount of bone removed by a condylectomy. If, at this stage, growth is still proceeding, the affected condyle is excised.

A

B

Fig. 8.—A, Photograph and X-ray of case of condylar hyperplasia; B, Post-operative photographs.

A condylectomy performed upon an individual of normal skeletal pattern is a most mutilating operation. Performed in the past for temporomandibular joint dysfunction, it invariably leads to disorganization of the opposite joint, a last condition which is worse than the first. This has not been so in cases of condylar hyperplasia. In only one case has slight transient discomfort of the opposite joint occurred, which settled in the course of a few months. A short while ago I reviewed as many of my cases as responded to recall and none had had any trouble—one over a period of as long as 8 years.

This would be expected on purely theoretical grounds. One is actually restoring the affected side to normal length and not, therefore, imposing any great degree of abnormal function upon the sound side.

Post-operatively early movement again is instituted. There is little or no post-operative pain, and the patients are able to get to work chewing gum the next day.

There are many other varieties of abnormality, both congenital and acquired, which time forbids me to deal with. If, however, the aetiological and functional anatomical approach is made to treatment planning in these cases, the best results will be obtained.

Acknowledgements.—My thanks are due to Mr. Battle for his encouragement and assistance in the treatment of these cases and to the Photographic and X-ray Departments of St. Thomas's and the Royal Dental Hospitals.

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DISCUSSION

Mr. Plumpton congratulated Mr. Hovell on a most interesting and instructive paper.

The surgical treatment of facial deformities presents many difficulties, and the results are often disappointing. The retrognathic mandible is generally unsuitable for radical correction because there is insufficient bone available for effective bone surgery. He personally preferred to restore facial contour by means of a plumper prosthesis worn in a pocket lined by an epithelial inlay in the buccal sulcus.

He had no experience of serial bone-grafting, but onlay grafts of bone or cartilage often give excellent results in restoring facial contour.

The treatment of ankylosis of the jaw is an immense problem. The general objective was to obtain and maintain movement, with cosmetic improvement a very secondary consideration. Condylectomy on one side may be necessary but should never be performed on both sides because of the very real danger of a complete trismus.

Unilateral condylar hyperplasia responded well to condylectomy of the enlarged condyle, especially if light elastic inter-maxillary fixation was maintained until the masticatory results had become adjusted to the new occlusal relationship.

Mr. MacLennan agreed with Mr. Hovell that the first arch deformities presented a different picture to the abnormalities of growth, which were postnatal in origin, e.g., trauma in relationship to the condylar growth centre. He suggested that perhaps the reason why onlay and other grafts were unsuccessful in the former was because of the early stapedial insufficiency, which was believed to predispose to such developmental anomalies and which no doubt provided the local tissues with a somewhat different vascular supply to the normal.

The relationship of the dental oral surgeon and the plastic surgeon, he felt, was one which could be considerably enhanced if the dental surgeon utilized the mechanical challenge to surgical skill, which in many cases he alone could provide.

Mr. MacLennan felt that "team" approach offered the best results in terms of success with many of the maxillo-facial problems, and was confident that as long as the dental surgeon limited his work and did it really well, time alone would ensure thereafter that his efforts were acknowledged by his surgical colleagues.

Mr. R. MacGregor asked if forms of post-operative muscular physiotherapy were used other than the chewing of gum.

Mr. D. Martin thanked Mr. Hovell for presenting such an interesting paper and asked how he would undertake the management of a case of first arch deformity diagnosed in infancy.

Mr. G. Beagrie questioned that if the notching of the affected side of the mandible was due to muscular pull, did Mr. Hovell consider that the muscles developed according to their genetic patterns irrespective of the pathological condition of the bone?

Mr. A. Cubie stated that, as healing would be adversely affected in the presence of blood deficiencies, did Mr. Hovell therefore, as a routine, order blood examination before bone-grafting operations?

Mr. Hovell in replying thanked Mr. Plumpton for his kind remarks.

He agreed with Mr. MacLennan that team work was essential for success.

With regard to Mr. MacGregor's question he found that the use of chewing-gum post-operatively was most effective and he used no other form of physiotherapy.

Mr. Martin's kind remarks were appreciated, and he suggested that serial bone-grafts could be tried, but the end results were poor. Prosthesis with epithelial inlays might be the answer.

In replying to Mr. Beagrie's question he stated that muscular pull had nothing to do with the notching of the mandible, but that growth had occurred in areas of the secondary growth centres and was not at all connected with the muscles.

To Mr. Cubie he replied that routine blood examination was not made, and was only done where an abnormal condition of the blood was suspected.

Mr. D. Logie closed the discussion by stating that:—

"It gives me great pleasure to thank Mr. Hovell for coming from London to address our Society and for the very interesting lecture he has given us. He is a stimulating speaker and the discussion that has followed his lecture is evidence of that.

"When one sees these photographs of 'dental cripples', one feels that oral surgeons are doing magnificent work in a very difficult field in very difficult conditions. Mr. Hovell is quite evidently an expert in this, as well as other, fields, and we are fortunate in having a man of such outstanding ability in the dental profession giving us to-day of the fruits of his experience.

"I call on members to accord him our hearty thanks."

ORAL SURGERY AND THE OCCLUSION

The development of oral surgery as a speciality and the training of the oral surgeon are described, and there follows a discussion on how oral surgery can effect the occlusion either by impairing it or improving it. The removal of teeth can alter the occlusion and the surgical extraction, that is, an extraction by surgical methods rather than by a forceps method, is the fundamental technique of oral surgery. The minimum requirements for any operation are a recent X-ray, a suction apparatus, a brilliant light, a trained assistant, and a tray of sterile instruments. Every surgery should contain such a tray of instruments in order to cope quickly with any untoward event in routine extractions. The procedure of a surgical extraction is divided into: (1) The approach, which means the formation of the flap made round the gingivæ of the tooth concerned and the tooth to the mesial and the distal and carried into the sulcus for $\frac{3}{4}$ in.; (2) The removal of bone, the chisel being given preference, and two-thirds of the buccal surfaces of the roots should be exposed and at least half their circumferences; (3) The removal of the tooth either with forceps or exolevers, and in the case of upper multi-rooted teeth apply buccal movement only when there will be less chance of the more inaccessible lingual root breaking; (4) The toilet of the wound and suturing.

Malocclusion from any cause can produce temporomandibular arthrosis or strain and the symptoms are pain and/or clicking in one or both joints which are usually brought on by movements such as mastication or yawning. The condition is simply strain in the joint which damages the meniscus or synovial membrane, and is caused by an unbalanced bite or loss of vertical dimension. These produce a too retruded position of the condyle in the glenoid fossa. The investigation of the condition would include radiographs with the teeth in occlusion and with the mouth open. In the normal closed position the condyles should be lying near the posterior surface of the articular eminence, with an adequate joint space behind, above, and in front of the condyle. Treatment consists in removal of the cause, using the dentatus articulator in cases requiring cuspal grinding, and adapting the patient's existing dentures in the case of loss of vertical dimension until the correct height of bite has been found before making new ones. If these measures fail condylotomy may be required, when an artificial fracture is produced and muscular action usually produces a condylar position where pain is not produced; intermaxillary fixation may be required for ten days.

Damage to the occlusion is caused when either jaw is fractured and the treatment will require the services of the oral surgeon. However, some cases can be treated by the general practitioner when it is possible to use eyelet wiring for fixation in the correct position.

The occlusion can often be improved by surgery, e.g., the prognathic mandible. In large mandibles orthodontic treatment cannot alter the formed skeletal pattern or have any effect on a prominent chin. Surgical treatment of these cases is never undertaken before the twentieth year when the growth centre in the condyle ceases to function. The general practitioner has the task of deciding whether the case should go to the orthodontist or to the oral surgeon for treatment.—LINDSAY, B. (1959), *Aust. dent. J.*, **4**, 223.

THE RADIOGRAPHIC LOCATION OF UNERUPTED MAXILLARY TEETH WITH THE VERTEX OCCLUSAL VIEW*

By **PETER D. BIRD**, L.D.S.

Senior Hospital Dental Officer in Dental Radiology, Liverpool Dental Hospital

MANY authors have emphasized the value of the vertex occlusal view when locating unerupted teeth in the upper jaw.

Despite this, there appears to be a fairly widespread lack of appreciation of the value of this view, especially in the fields of orthodontics and of oral surgery where the accurate location of unerupted teeth may be of importance.

It is because of this that it is felt that a brief review of the radiographic factors employed when making use of the vertex occlusal view may be of value, and more particularly that a comparison between the accuracy of this view and that of the standard midline occlusal view may again be considered.

THE STANDARD MIDLINE OCCLUSAL VIEW OF THE UPPER JAW

The radiographic technique is as follows:—

1. *Film Position.*—The film is placed horizontally, with the short axis coincident with the sagittal plane, and as far back in the mouth as to cover the third molar region.

2. *Patient's Head Position.*—(*a*) Sagittal plane vertical; (*b*) Occlusal plane of the upper jaw horizontal.

3. *Tube Position.*—(*a*) Vertical angle: +65° to +70° (varying according to one's personal assessment of the degree of prognathism of the patient's upper jaw), with the tube directed posteriorly in relation to the patient's head; (*b*) Horizontal angle: adjust to sagittal plane; (*c*) Vertical height: tip of cone over bridge of nose.

4. *Exposure Time.*—At a tube rating of 10 mA. and 60 kVP. and using fast film: about 1½ sec.

Assessment of this View.—It gives a fairly clear topographical view of the upper jaw with the advantage of being symmetrical (so that the right and left sides may be compared). Useful in confirming the presence of buried

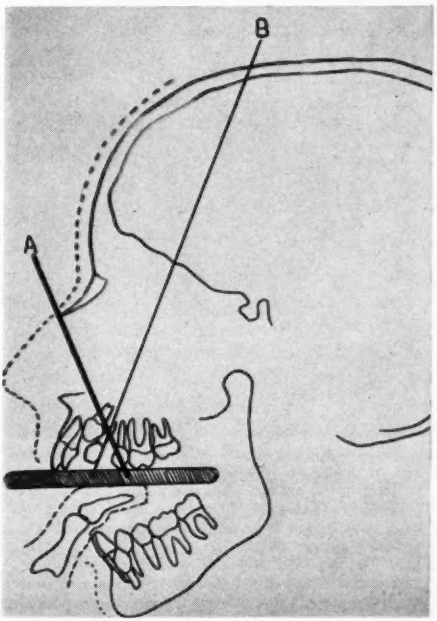


Fig. 1.—A tracing of a cephalometric radiograph taken to show an occlusal cassette held against the maxillary teeth. The direction of the central ray for the standard midline occlusal view is indicated by line (A) and that for the vertex occlusal by line (B). Note the angulation and direction of these lines in relationship to the upper incisors and canines.

teeth, supernumerary teeth (unerupted), cysts, clefts, etc.

The main disadvantage is that an unerupted tooth in the 3|3 region being high off the film, will be projected in a backward direction and will therefore always appear to be palatally placed. This can lead to grave errors in the interpretation of the film if this fact is not fully appreciated—as will be seen later.

* Casual communication, presented at the meeting of the British Society of Dental Radiology on October 15, 1959.

THE VERTEX OCCLUSAL VIEW

The radiographic technique is as follows:—

1. *Film Position.*—As with standard midline occlusal view.

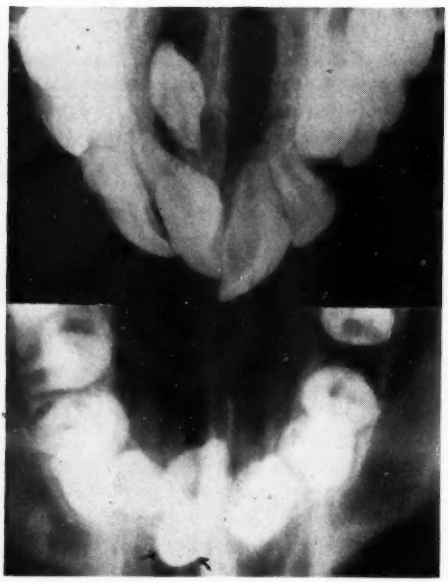


Fig. 2.—A, Showing the standard midline occlusal view taken of the patient, M. J. The $\underline{1}|$ appears to lie with its crown more labially placed and its root apex more palatally placed compared with $|\underline{1}$. $\underline{1}|$ is also inclined mesially and rotated. In this view the supernumerary appears to lie horizontally in the palate with its crown posterior and its apex anterior. B, Showing the vertex occlusal view of the same case, taken with the centre ray parallel to the long axis of $\underline{1}|$. This discloses the true position of the supernumerary just labial to $\underline{1}|$.

2. *Patient's Head Position.*—As with standard midline occlusal view.

3. *Tube Position.*—(*a*) Vertical angle: $+70°$ to $+80°$ with the tube directed *anteriorly* in relation to the patient's head. The angle varies slightly according to the inclination of the patient's forehead and teeth. (*b*) Horizontal angle: adjust to sagittal plane. (*c*) Vertical height: tip of cone at the level of the coronal suture.

4. *Exposure Time.*—With the tube rating as before and using an occlusal cassette: about 2 sec.

Assessment of this View.—Due to superimposition of the frontal bone, ethmoidal sinuses, etc., there is insufficient clarity to diagnose clefts, cysts, etc., but the labio-palatal relationship of the teeth is demonstrated.

This is mainly because the central rays pass along the axes of the teeth and a plan view is so obtained.

Note: Whereas the lateral shift method will determine whether an erupted tooth is lying labially, palatally, or in the arch, the vertex occlusal view will show to *what extent* it lies labially or palatally.

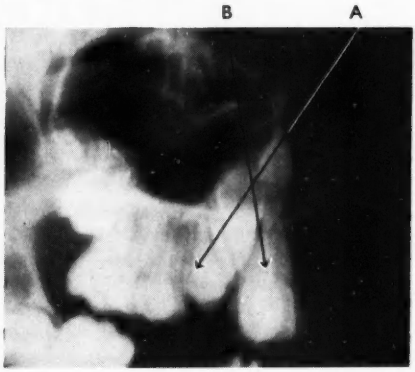


Fig. 3.—A true lateral view of the maxilla taken of the patient, M. J. The direction of the central ray for the standard midline occlusal view is indicated by line A and that for the vertex occlusal by line B. Note the angulation and direction of these lines in relationship to the supernumerary tooth.

The following case brings home the importance of correct interpretation:—

CASE REPORT

Maureen J., aged $8\frac{1}{2}$ years, was referred for radiography of $\underline{1}|\underline{1}$ region with a request for periapical and standard midline occlusal views.

The periapical view confirmed the presence of a supernumerary tooth lying in an inverted position and to the right of midline.

The occlusal view showed that the tooth appeared to be lying *palatally* to $\underline{1}|$ (*Fig.* 2 A). Unfortunately, operation was undertaken at this stage without any further radiography being requested. The operation was performed under local anæsthesia, an incision was made in the palate, and after removal of bone, the *tooth was not found* and the flap was sutured.

The patient was referred for further radiography and a vertex occlusal view was taken (*Fig.* 2 B).

This showed the supernumerary tooth to be lying *labially*.

Note: The extreme difference between the position shown in the standard midline view and the vertex occlusal view would indicate that the tooth must be lying very high off the film. Therefore, a true lateral view of the maxilla was taken (*Fig.* 3). The supernumerary tooth appears to lie vertically with its crown upwards in the nasal fossa. Its apex is mesial to and on a rather more labial plane than the apex of $\underline{1}|$. It appears also to be lateral and anterior to the nasal end of the incisive canal. One would expect the root to be covered by bone arising up from the nasal floor and probably joined to the nasal notch of the maxilla laterally. There is no follicular space around the crown of the supernumerary tooth and it is probable that this is covered by nasal mucosa only. The point of its crown is at the level of the conchal crest of the maxilla.

BOOK REVIEWS

ORAL RADIOGRAPHY. By W. H. JOHNSON, F.S.R. $11 \times 8\frac{1}{4}$ in. Pp. 145, with 329 illustrations. 1959. Published by Ilford Ltd., in association with William Heinemann (Medical Books) Ltd. 42s.

THIS is a magnificently produced book, and all who have had a hand in its production deserve credit for this. Binding, paper, printing, and illustrations are all of very high quality.

In simple language it deals with the production of X-rays, protection, basic anatomy, technique, processing methods and equipment, mounting, and viewing. Film faults are illustrated and an appendix covers exposures with various dental X-ray sets.

Criticisms of this work are few. Minor errors were noted in the anatomy section, and the reference in the text to Fig. 211b does not clearly explain the picture. This illustration is referred to as a full panoramic view extending from mastoid to mastoid, and the context implies that it includes the jaws. To the reviewer it appears to be a pantomogram from mastoid to mastoid of the occipital region.

The specialist dental radiologist and radiographer might find the book a little disappointing and consider some of the techniques described to fall short of their own exacting requirements, but for the general dental practitioner it should be ideal. The general radiographer also, who may only have a limited knowledge of this kind of work, should find it most useful and the clear manner in which all aspects of dental radiography are described should appeal to the dental student.

G. R. S.

HIGH SPEED AND ULTRA SPEED IN DENTISTRY. Equipment and Procedures. By HAROLD C. KILPATRICK, D.D.S., and 14 contributors. $9\frac{1}{4} \times 6\frac{1}{8}$ in. Pp. 289+xii, with 429 illustrations on 230 figures. 1959. Philadelphia and London: W. B. Saunders Co. Ltd. 59s. 6d.

ONE criticism of this book would be to say that the author has put too much in and in too great detail, but on the other hand the practitioner who is interested in a comprehensive survey of the subject will find it most useful. The author discusses all the equipment on the market employing rotary methods: gear-driven, belt-driven, and turbine-driven equipment. He describes in detail each make, its use, maintenance, advantages and disadvantages, as well as auxiliary equipment such as water-cooling systems. The book is profusely illustrated throughout, but reflects the author's determination to give every small detail in such a way that the reader has difficulty at times in seeing the wood for the trees. The chapters on procedures are of value and will help in the selection of cutting instruments, but the techniques advocated by the numerous contributors are so short and repetitive that this section is questionable. It is a pity that so much

of the book is presented purely from the mechanical point of view, when an extended chapter on its biologic effects would have been of prime importance. It is largely a reference book on mechanical rotary instruments which will undoubtedly have a wide appeal to the profession, despite its drawbacks.

N. L. W.

HANDBOOK OF DENTAL PRACTICE. Edited by Louis I. Grossman, D.D.S., Dr. med. dent.; Professor of Oral Medicine, School of Dentistry, University of Pennsylvania. With 23 contributors. Third Edition. $10 \times 6\frac{7}{8}$ in. Pp. 534+xiv, with 514 illustrations and 4 colour plates. 1959. London: Pitman Medical Publishing Co. Ltd. £5.

When the knowledge and experience of twenty-four men, each a recognized authority in his respective field, is compiled into a single volume, it cannot but be a source of infinite interest and information.

Such is the *Handbook of Dental Practice* edited by Louis Grossman. It would be quite impossible to discuss this volume at length, and impertinent to single out any one or other of the authors for either praise or criticism, for the material contained therein covers so wide a range of practice that such would result in a volume in itself.

It is absorbing in its entirety, well and effectively illustrated, and can be strongly recommended to any practitioner both for reference and as a valuable adjunct to his library.

F. D. D.

LETTERS TO THE EDITOR

February 9, 1960.

Dear Sir,

I feel that your Editorial "Solving the Problem of the School Dental Service" (January, 1960) calls for some comment and protest.

I have been a School Dental Officer for over forty years and have witnessed a steady improvement in the status of that branch of dentistry. Not very long ago the profession was divided into "school dentists" and "proper dentists", but that distinction no longer applies. If, however, you are going to turn newly qualified men and women loose on children, as is suggested, you are going to go back to the bad old days. It should be realized that there are many factors in the successful treatment of children which have to be learned by experience and more experience. No one expects these qualities to be present in the newly qualified man or woman, many of whom have an innate dislike to treating children to start with. A child soon tires and speed in work is an essential. An ability to work and carry on a cheerful conversation with your child patient is another essential. I would say that most of the qualities which are naturally lacking in the newly qualified are precisely those qualities which are necessary in the successful children's dentist. A child's first contact with dentistry is of great psychological importance and children are very sensitive to any degree of fumbling and inefficiency.

I am afraid that I have no easy solution to offer, but I would have thought that first and foremost came the need for complete autonomy of the Dental Service in the Public Health Service. Secondly, Local Authorities should be made or persuaded to realize that if they want the greatest efficiency and the highest type of man to be tempted into their Service, they will have to pay them enough to compete with private enterprise, and recognize that unless a man is treated fairly and with some consideration and courtesy and given a touch of comfort, he will not put up with the necessarily somewhat rigorous discipline which a public servant must endure. By this I mean the fixed hours of duty and, I regret to say in some Authorities, the set amount of work expected from their officers and the strict limitations on materials and types of work that an officer is allowed to do. These conditions naturally cause many men to shun Public Dental Service as a career. I have always thought that it would be a good thing if the School Dental Service was taken out of the hands of the Local Education Authorities and run under the Executive Councils, the School Dental Clinics becoming Health Centres for the Priority Classes—but that is another story.

Yours faithfully,

B. R. Townend
(Chief Dental Officer).

Central Dental Clinic,
The Elms,
9 *Bond Street,*
Wakefield.

March 16, 1960.

Dear Sir,

May I congratulate you on your January Editorial? Your suggestion that the newly qualified graduate or licentiate be required to serve in the School Dental Service for one year is worthy of the closest attention. The neonate dental surgeon could thus delay having to pay surtax for another year and at the same time greatly increase his knowledge of children's dentistry in its many interesting and rewarding aspects. It would also give those whose expenses were met by grants the opportunity to repay their debts. The School Dental Service would be more able to fulfil its vital tasks, viz., the prevention and treatment of dental diseases.

Yours faithfully,

Norman R. E. Robertson.

13 *Meads Close,*
Knutsford,
Cheshire.

NEW MATERIALS AND APPLIANCES

THE new materials and appliances briefly reported here have recently become available to the profession. For further information the reader should write direct to the manufacturer.

Nebrinal Tablets

NEBRINAL tablets contain nephenesin and pentobarbitone in a combination formulated to produce relaxation and sleep by central sedation. A special feature is "tapered" dosage. The tablet is made in two layers. The ante-shell dissolves rapidly to release about two-thirds of the drugs to induce sleep. An inner core disintegrates 3–4 hours later to sustain relaxed sleep on the reduced dose, tapering towards morning. This prevents "hangover" on awakening. Bottles of 50 and 250. Basic price: 4s. for 50 tablets. (A. Wander Ltd., 42, Upper Grosvenor Street, London, W.1.)

Xylotox Oral

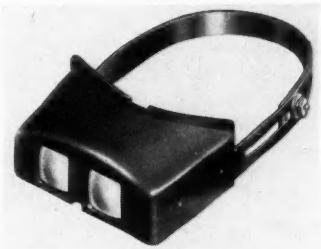
XYLOTOX Oral contains lignocaine hydrochloride in a flavoured viscous base. It is of great value in the treatment of patients with hyper-sensitivity of the palate and tongue, particularly when impressions have to be taken. A suitable amount is held in the mouth for some two minutes and finally swallowed, immediately before impression taking. This can then be carried out easily and without reflex gagging. (Pharmaceutical Manufacturing Co., Epsom, Surrey.)

Zactirin Tablets

ETHOHEPTAZINE, although chemically related to pethidine, is different from it pharmacologically, including freedom from addictive and central depressive effects. Zactirin tablets contain a central core of 75 mg. ethoheptazine citrate, 325 mg. aspirin, and 97 mg. calcium carbonate. Zactirin is indicated in cases of pain of moderate severity, regardless of aetiology. Transient nausea, epigastric distress, and dizziness may be experienced, but these are only likely to be of a transient and minor nature. Euphoria, hypnosis, and sedation are not experienced and the drug is non-addicting. Basic N.H.S. cost: 10 tablets, 2s. 1d. plus purchase tax. (John Wyeth & Brother Ltd., Clifton House, Euston Road, London, N.W.1.)

Ellis Headband Magnifier

THE Ellis Headband Magnifier gives a magnification of $2\frac{1}{4}$ times with a focal distance of 8 in. It is constructed of strong, light-weight plastic material. The hood extends over the



top and sides. The lower side is open, allowing unrestricted downward vision. It can be used continuously without discomfort or eyestrain, and may be worn over spectacles. Price: £1 16s. (Ellis Optical Co., Mayday Road, Thornton Heath, Surrey.)

Antoin Tablets

ANTOIN tablets contain calcium aspirin, phenacetin, caffeine citrate, codeine phosphate, and nicotinamide. This combines the advantages of aspirin, phenacetin, and codeine. The addition of nicotinamide is based on its vasodilatory properties, which, by improving local circulation, is thought to assist the analgesic and antiseptic effects of the other drugs. Available in containers of 10, 20, and 50 tablets, also dispensing packs of 250, 500, and 1000 tablets. (Allied Laboratories Ltd., 140, Park Lane, London, W.1.)

ABSTRACTS FROM OTHER JOURNALS

Diabetes and the Dental Patient

The number of cases of undiagnosed diabetes is probably greater than the dental practitioner realizes. Figures given by the United States Public Health Service indicate a prevalence of 1·7 per cent in the population. From this it is estimated that there are over 2,000,000 diabetics in the country with 3 undiagnosed cases for every 4 known cases. The dentist may, therefore, play a significant part in the detection of previously undiagnosed diabetics, providing full note is taken of any general signs or symptoms.

The principal symptoms are loss of weight, increased thirst, and an increase in the volume of urine. A fruity haletosis known as "acetone breath" and occurring in diabetic acidosis may first be noticed by the dentist. Other symptoms are a lowered resistance to infections, itching, drowsiness, leg cramps. Lowered resistance to infection shows itself in boils and slowness in healing of cuts and wounds.

In uncontrolled diabetes mellitus, oral lesions may occur, though these are not specific, simulating vitamin B and C deficiencies and disturbances in calcium metabolism. The gingivæ may be hypertrophied, painful, inflamed, and bleeding, though this may be similar to the appearance in scurvy and monocytic leukæmia. There may be dryness and burning of the tongue and painless swelling of the parotid glands. Extensive necrotic lesions may develop spontaneously or may follow surgical procedures.

Oral surgical procedures are therefore contra-indicated if the patient is suspected of being an uncontrolled diabetic. Antibiotics as prescribed by the patient's physician are advisable and pre-anæsthetic medication will allay anxiety and keep the blood-sugar level down in the controlled diabetic. It is recommended that local anæsthesia be used wherever possible, preferably without adrenaline, and that extractions be limited to a few teeth at a time. Two per cent lidocaine is recommended as having a mild but safe vasoconstrictor action. Iodine should not be used on the mucosa, as it has a pronounced necrotizing effect in diabetics.

Infection anywhere in the diabetic intensifies the diabetes and therefore periodontal disease and chronic periapical infection should be attended to quickly. Any teeth remaining loose after control of the diabetes and appropriate periodontal treatment should be extracted. However, there is no justification for the removal of successfully root-filled teeth.—BURKET, LESTER W., and SINDONI, ANTHONY (1959), *J. Amer. dent. Ass.*, **58**, 81.

A Desquamative Cytological Study of the Gingivæ and Oral Mucosæ in Women

Desquamative cytological examinations were made of the oral mucosæ and gingivæ twice weekly on a group of 11 females for a period of 3 months. In two individuals the period was extended to 4 months and in another two for 5 months. The slides were stained by Shorr's method and grouped into four groups according to the technique of Papic and Glickman.

Although variations in the degree of keratinization were observed, particularly in the case of the vestibular mucosa, no evidence was found of a cyclic pattern which could be related to the menstrual cycle.—TROTT, J. R. (1958), *J. Periodont.*, **29**, 213.

The Effects on the Epithelial Attachment of Extraction of Adjacent Teeth in Macacus Rhesus Monkeys

Extraction of a tooth caused tearing of the epithelial attachment on the adjacent tooth in 14 extraction wounds in Macacus Rhesus monkeys.

In specimens where there had been a time lapse of one week before sacrifice of the animals there was little evidence of injury, although the attachment tended to be at a more apical level and there was generally a more marked infiltration of inflammatory cells beneath the epithelium on the side of the tooth adjacent to the socket.—SIMPSON, H. E. (1959), *J. Periodont.*, **30**, 124.

THE LATERAL ARM IN REMOVABLE APPLIANCE THERAPY

By JOSEPH ANGELMAN, H.D.D. R.C.S., L.D.S.
Orthodontic Service, Lancashire County Council

THE lateral arm is a 0·9-mm. wire extension from the distal aspect of the appliance passing forward across the buccal segment towards the midline, its length depending upon the tooth or teeth to be moved. Its distal end has a U loop for adjustments, and its mesial end is flattened and modified according to the type of movement to be employed, as described below. Its use can be extended to:—

1. Rotation of anterior teeth.
2. Palatal or lingual movement of incisors, canines, and premolars.
3. Framework for springs for individual tooth movement.
4. Framework for single or multiple apron springs.
5. Retention appliances.

ROTATION OF TEETH

The lateral arm extends from the molar area to the tooth to be rotated, the anterior end being curved to engage the everted edge of the rotated incisor. Palatally a boxed, coiled U spring of 0·5-mm. wire engages the opposite end of the tooth. The main pressure is exerted by the palatal spring, the lateral arm being almost passive, but activated sufficiently so that the tooth rotates between two diagonally opposed pressures (*Figs.* 1, 2).

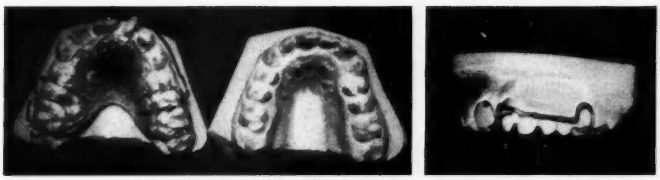


Fig. 1.

Fig. 2.

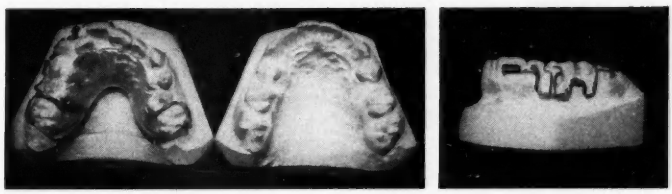


Fig. 3.

Fig. 1 illustrates a case in which $\underline{|1}$ is rotated through an angle of 85° with an auxiliary spring on $\underline{1|}$ moving it distally to provide sufficient room for $\underline{|1}$ in the arch.

Demonstration given at the Manchester meeting held on April 18, 1959.

Fig. 2 demonstrates the rotation of |1 which was originally in linguoversion together with 21|, the labial movement being effected by opening the bite and operating the coiled palatal springs only. When the teeth had been moved labially |1 was rotated by activating the lateral arm.

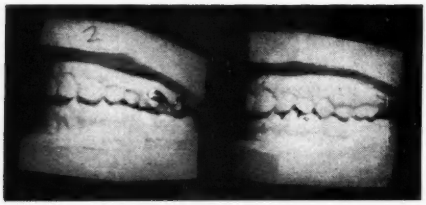


Fig. 4.

PALATAL AND LINGUAL MOVEMENT OF TEETH

Fig. 3 shows the lateral arm modified to correct overcrowding in the labial and buccal segments. Following the removal of 4| the lateral arm has a T-shape dapron spring wound on it to move 3| distopalatally, and its curved anterior end is activated to retract 1|. A coiled palatal spring moves 2| labially. This appliance also demonstrates the use of the lateral arm as a framework for springs for individual tooth movement. *Figs.* 10, 11 show the appliance in use bilaterally in the correction of 2|3. *Fig.* 4 shows the simple palatal move ment of |4 into normal occlusion in the arch.

Fig. 5.

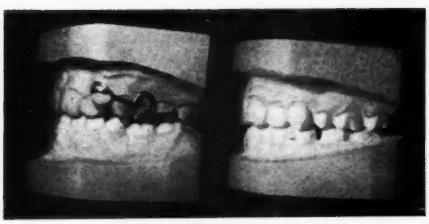


Fig. 6.

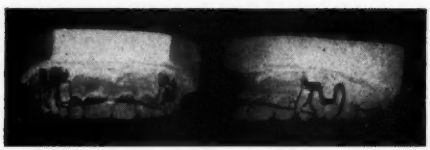


Fig. 7.

Fig. 8.

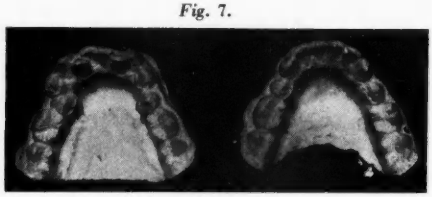


Fig. 9.

Fig. 10.

Fig. 11.

RETRACTION OF CANINE AND PREMOLAR TEETH

The flattened end of the arm is curved to embrace the mesial aspect of the tooth to be moved, and the distal loop activated to exert pressure on this surface. Due to the stability of the lateral arm, and the area of the crown surface engaged, bodily movement of teeth is achieved. *Figs.* 5, 6, 8, 9 illustrate the construction and action of these appliances.

FRAMEWORK FOR SINGLE OR MULTIPLE APRON SPRINGS

The use of an appliance with a high labial bow for the retraction of the labial segment sometimes produces traumatic pressure against soft tissues of the lip at the mucobuccal fold. As the teeth are retracted, there is a varying degree of upward riding of the bow which may encroach on the soft tissues, more especially where the depth of the alveolar area is small and the frenal tissues thickened and curved downwards close to the alveolar margin.

The more pronounced the inclination of the long axis of the teeth in the labial segment, the more likely the upward movement will occur as retraction proceeds, and the pressure may involve any area in the mucobuccal fold between the limits of the high labial bow.

Various appliances have been designed to obviate the use of the high labial bow when employing apron springs, the disadvantage being the difficulty of repair if fracture should occur, which usually involves a major workroom procedure or a new appliance. These difficulties may be overcome by the use of bilateral arms extending as far as the canines on either side to form a framework for the fixation of one or more apron springs. This framework is sufficiently rigid, and in the event of apron spring fracture, a new one can be rewound at the chairside. The minimum amount of framework lies between the alveolar and lip tissues, and continued comfort during use is ensured. An added feature is that the curved anterior ends of the arms can overlie the vertical sides of the apron springs, thus preventing labial distortion during use. *Fig.* 7 illustrates this type of appliance with a triple apron spring for the retraction of the labial segment.

Pressure exerted by the lateral arms in tooth movement is regulated by means of a Richmond pressure gauge, and varied between 15 grammes in the rotation of anterior teeth to 60 grammes in the retraction of canines as initial pressures. Periodic radiographic examinations were made during and following treatment, and in no case has any pathological change been observed. Comparative studies with fixed appliances using more continuous forces showed the latter to produce evidence of bone and root changes.

Acknowledgements.—Appreciation is expressed to Dr. S. C. Gawne, County Medical Officer of Health, Lancashire County Council, and Mr. L. B. Corner, Principal School Dental Officer, for permission to use cases treated in the Orthodontic Clinic.

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— — (1959), *Ibid.*, **9**, 80.
REITUN, K. (1956), *Proc. Europ. Orthod. Soc.*

Bilateral Inverted Supernumerary Central Incisors Penetrating Nasal Cavity

The case is reported of a man aged 20 years who was found to have two unerupted supernumeraries. His only complaint was of a blocked nose. Periapical and occlusal radiographs demonstrated the teeth, lying apparently palatal to the upper central incisors and with their crowns pointing upwards. A lateral view of the maxilla confirmed the palatal relationship of the two teeth and also indicated that their crowns lay above the bony nasal floor. Inspection of the nose then revealed the crowns presenting into the nostrils.

A palatal flap was reflected, bone was removed, and the teeth punched into the nose with an elevator, from where they were recovered with a curette. Healing was uneventful and the nasal blockage cured.—QUINN, JAMES H., and LEWIS, MILES (1959), *J. oral Surg.*, **17**, 61.

A MODIFIED ELECTROLYTE FOR POLISHING STAINLESS STEEL

By J. H. MARTIN, L.D.S., D.Orth. R.C.S.
The Charles Clifford Dental Hospital, Sheffield

In 1948 Professor Hallet published the formula for an electrolyte suitable for polishing stainless steel, and in 1955 Duffield gave an account of two solutions which he used to clean chrome cobalt castings. The method of thinning a 1·0-mm. wire to produce a self-supporting spring has necessitated the development of a solution whose action takes as little of the technician's time as possible.

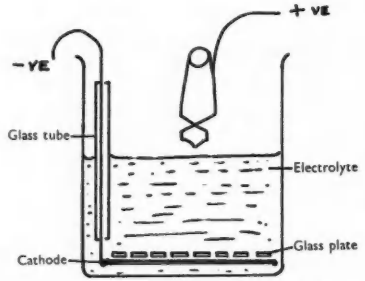

Fig. 1.—To show arrangement of cathode and anode in the electrolyte.

In conjunction with the Metallurgy department of the University of Sheffield the following solution has been tried and found to have a useful action:—

Sulphuric acid	41	per	cent	by	volume
Phosphoric acid	45	,,	,,	,,	,,
Ferrous sulphate	5	,,	,,	,,	,,
Water	9	,,	,,	,,	,,

It is based on a common industrial electrolyte with the addition of the ferrous sulphate to act as a buffer.

The demonstration showed an arrangement of apparatus suitable for the general practitioner, viz.: a 4 amp. battery charger connected to a circular stainless steel cathode which was placed in a 500 ml. beaker. A perforated glass plate was placed over the cathode to prevent the appliance touching the cathode and causing an accidental short circuit. A home-made spring clip to hold the article was connected to the positive lead (*Fig.* 1). A high polish was shown to be produced on a previously charred wire within about 10 seconds. The glass safety plate acts as a barrier to the liberation of gas bubbles from the cathode and thereby slows the action of the electrolyte; if it is removed a 1·0-mm. wire can be reduced to a diameter of 0·7 mm. in 12 minutes (*Fig.* 2).

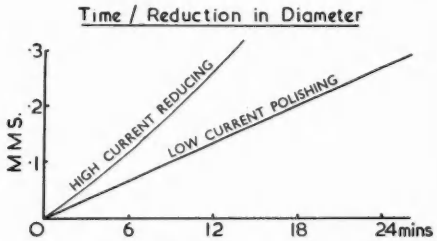

Fig. 2.—Graph indicating rate of dissolution of stainless steel wire.

A MODIFIED JACKSON SPRING

By J. H. MARTIN, L.D.S., D.Orth. R.C.S.
The Charles Clifford Dental Hospital, Sheffield

In 1904 V. H. Jackson published a diagram of a labial spring to retrocline upper incisors. It consisted primarily of a self-straightening wire. Both ends were free and the appliance tended to be unwieldy and difficult to adjust adequately. The first modification was produced by

Demonstrations given at the Manchester meeting held on April 18, 1959.

fixing one end of the spring to a stiff labial bow. This caused a varying pressure along the length of the wire and was partially overcome by fixing a similar wire to the opposite side of the labial bow. Because of this, adjustment was limited.

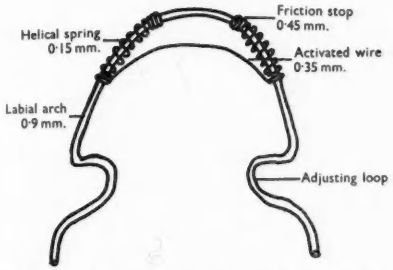

Fig. 1.—To show arrangement of helical spring on labial arch.

By using helical springs on a facial arch these difficulties have been overcome. The demonstration showed cases in which the modified Jackson spring had been used and details of the construction of the spring are shown in *Fig.* 1. The completed spring arch may be attached to buccal tubes on molar bands or soldered to the cribs of a removable plate. The advantages claimed are:—

1. Compactness and ease of adjustment.
2. Usefulness in cases of marginal gingivitis where a conventional apron spring is contra-indicated.
3. Ease of dealing with asymmetrical conditions by moving the friction stops and the activated wire round the arch.

Study of Tissue Response to Polyvinyl Resin Sponge Implants in the Jaws of Dogs

Following favourable reports on the use of polyvinyl sponge in general surgery, it was decided to investigate its use to promote regeneration of bone after surgery or natural resorption had reduced the size of the alveolar processes.

Premolar teeth were removed from dogs, and the ridges allowed to heal. The implant material was inserted at a second operation, either as an inlay or an onlay. In all cases the implant was higher than the ridge, relaxing incisions being required in the periosteum to allow complete closure of the wound. Full asceptic precautions were observed and intramuscular penicillin was given.

Clinically, after 4 weeks the implant felt as hard as bone. Some implants ulcerated into the mouth. A few were replanted.

Microscopically at four weeks the implant was filled with white cells and a few giant cells and was being invaded by granulations. Unless the area ulcerated the inflammatory cells had disappeared by 8 weeks. All told, 28 weeks were required before bone was formed on the surface of the implants.

The material was felt to be unsuitable for the intended use in man, as in one-third of the cases the implant became exposed to the mouth and because bone was too slow in penetrating the mass. The technique of implanting the sponge did not affect the result. —Dresser, W. J., and Clark, H. B., jun. (1959), *J. oral Surg.*, **17**, 3.

Mandibular Micrognathia corrected by Vertical Osteotomy in the Rami and Iliac Bone Graft

The details of the operative procedures used to correct mandibular micrognathia, first reported in 1954, are repeated following the successful treatment of further cases. Two new cases are reported.

The operation is planned on a cephalometric radiograph and study models. The coronoid process is cut through and the ramus divided vertically in the region of the inferior dental foramen. A broad zone of ramus, anterior and posterior to the lower part of the vertical cut, is denuded of cortex and a T-shaped block of cancellous bone from the iliac crest wired into position as a graft.

With this method a field free of oral contamination can be assured; the contents of the inferior dental canal are preserved; early bony union can be obtained; the teeth are unharmed and a good functional and cosmetic result is obtained.—Caldwell, J. B., and Amaral, W. J. (1960), *J. oral Surg.*, **18**, 3.

EARLY DEVELOPMENT OF THE DECIDUOUS DENTITION

(OROFACIAL MUSCULAR DEVELOPMENT)

By **B. C. LEIGHTON**, L.D.S. R.C.S., H.D.D. R.F.P.S.
King's College Hospital Dental School

It is nearly fifty years since Northcroft (1910), in the course of his Presidential Address to the British Society for the Study of Orthodontics, expressed amazement at the enormous number of abnormalities that are foreshadowed in the deciduous dentition before the age of 5 years. Reference to other literature of the early twentieth century suggests that it was widely believed that malocclusions of the deciduous dentition rarely occurred, a view shared even by Edward Angle (1907). In 1912 E. A. Bogue wrote: "We have been assured that the temporary teeth are always or usually regular, but I shall show that from the age of 3 to 6 years the temporary teeth are frequently irregular in position, and that they fairly indicate the irregularities which are impending among the permanent teeth."

The same belief was later expressed by J. H. Badcock (1931) when addressing the Second International Orthodontic Congress. He said: "Irregularities of the second set of teeth are foreshadowed in the first, and even at birth future malrelation of the jaws may often be detected."

Although the published works of Ainsworth, Chapman, Hellman, Northcroft, Pitts, Wilson Charles, and others have shown conclusively that malocclusion does occur in the deciduous dentition, there has been a remarkable paucity of evidence to support Bogue's assertion that the deciduous does foreshadow the permanent dentition. In fact so little seemed to be known about dental development during the early years of life that it was decided that much might be gained from a longitudinal survey starting from birth. By this means it may be possible to observe the environment into which the deciduous teeth erupt, and then to follow subsequent changes, both of environment and of morphology. A survey was, therefore, started in 1952 in the Maternity Department of King's College Hospital. About 550 babies were examined with the intention of following them up; however, there was considerable wastage for a variety of reasons, and there are now only about 200 of the original cases still attending. The children were examined at birth, at six months, and then at yearly intervals. Records were kept of birth conditions, and at each visit impressions were taken and notes made of sucking habits, lip posture, swallowing behaviour, and weight and height. From the age of 3½ lateral X-rays were taken of the majority of children. It is not possible to cover all the information gained from this survey in one paper, which is limited, therefore, to that part of the survey dealing with orofacial muscular behaviour. Although this subject is at present rather nebulous, and, by its nature, does not lend itself to mathematical analysis, it has gained so much prominence during the last two years that some attempt should be made, in spite of the difficulties, to subject it to analysis.

Since 1946, when R. E. Rix drew attention to differences of swallowing behaviour in older children, and suggested that some of these may be associated with malocclusion, there has been speculation on the origin of those behaviour patterns in which swallowing takes place with the teeth apart.

Nord (1959) was convinced that the behaviour of the tongue and lower lip during deglutition is determined by the incisor relationship, a large overjet encouraging tongue to lip contact at the moment of swallowing. He also denied any hereditary factor in determining behaviour on the ground that

Given at the meeting held on October 12, 1959.

exercises can be used to alter oromuscular behaviour.

Popovic-Ejdus (1959), after examining 271 children between 2 and 13 years of age, concluded that abnormal swallowing represents a delay in the functional adaptation of the musculature. He based his opinion on the difference of incidence of the infantile type of swallowing that he found between 2 years (49 per cent) and 12 years (23 per cent).

In 1952 Gwynne-Evans, after describing the intermediate position of orofacial muscles between visceral and somatic types of behaviour, concluded that swallowing with the teeth apart was often a manifestation of the predominance of a visceral type of behaviour. In 1955 he stated that "it is quite likely that individual characteristics of the atypical swallowing behaviour are inherited".

Ballard (1952) was not at all convinced that the abnormal swallow could be said to be a continuation of the infantile swallow. He had thought originally that many of these abnormal swallows resulted from an abnormality of the skeletal pattern in early childhood, and that behaviour patterns of the lips and tongue during swallowing became abnormal in their attempt to adjust themselves to this abnormality. He had found, however, that many abnormal swallowing actions were based on an entirely normal skeletal pattern, and many were present in early childhood when every other factor appeared to be normal. He had examined a large number of children between the ages of 2 and 5 years: the abnormal swallow was present in a considerable percentage of them (although most of the children with an abnormal swallow had a normal skeletal pattern), and its manifestation in the deciduous dentition was a slight degree of increased overjet and reduced overbite in the incisor region. He still felt that an explanation of the abnormal swallow was that it was inherited. It should be mentioned, however, that Ballard offered no evidence at the time to support his researches on very young children. In 1955 Ballard still asserted that "it would appear, then, that patterns of motor activity develop endogenously and that what we have thought to be learning is, in fact, the result of the processes of maturation of the central nervous system".

It would appear, therefore, that the variations of swallowing behaviour seen in older children might arise in a number of possible ways:—

1. They may arise because the morphological environment renders normal swallowing difficult or even impossible.
2. They may be either a failure or delay in maturation of the infant suckling behaviour.
3. They may be the result of an inherent endogenous pattern of behaviour, operating independently of skeletal morphology.

In order to elucidate this problem further, a logical step would be the examination of a series of children periodically from birth, recording details of both morphology and behaviour. By this means it may be possible to learn whether subsequent atypical swallowing behaviour is associated with a particular arch relationship at birth, at what age behaviour becomes differentiated into types, and whether there are any signs that behaviour matures.

It had originally been intended to rely on clinical examination to record details of swallowing behaviour. This was found, however, to be unsatisfactory, especially if subsequent comparison were to be made. There was also the disadvantage that when the assessment was made other details of morphology would be known; this may permit an unconscious tendency to fit the behaviour to the morphology. It seemed desirable, therefore, to make some permanent record of the swallowing behaviour of these children. For accomplishing this there are a number of possibilities:—

1. Ciné photography.
2. Ciné X-ray photography using an image intensifier.
3. Electromyography.
4. Pressure gauges distributed at strategic points in the mouth.

The last two methods are only of value when some knowledge has already been obtained about the type of behaviour being examined. Furthermore, they would tax the

patience of the keenest investigator on such young children. The use of ciné film seemed to offer the most practical method of recording in spite of the disadvantage that only movements of the lips would be shown. The possibility of using 8-mm. ciné film was suggested by Mr. K. P. Liddelow, who had been experimenting with it as a medium for teaching. This would be not only a permanent record suitable for comparison with subsequent film, but could be played repeatedly for closer analysis independently of other clinical findings. Its comparative cheapness and simplicity make it possible to film the children from the age of 18 months. In order to overcome the disadvantage that only movements of the lips are recorded, attempts were made to part the lips during swallowing to show activity within the mouth. This, however, was found to upset behaviour sufficiently to render such observations useless. It seemed, therefore, that if the typical behaviour of the tongue and mandible are to be observed, the examination should be carried out without interfering with the movement.

Ciné X-ray film has the advantage of offering information about tongue behaviour, as well as movements of the mandible. This film can only be prepared, however, by using an image intensifier. At present the use of this machine is limited by the amount of radiation considered safe for the patient, that is, about 10 sec. filming for a 3-year-old. Being both large and expensive it is difficult to gain access to this equipment. Owing to the generosity of Dr. I. MacLaren, the Director of the X-ray Department of St. Thomas's Hospital, permission was obtained to take 12 cases to St. Thomas's Hospital for this examination. The number was limited for geographical and economic reasons.

Table I.—Mean Dimensions of Overbite at Birth of Infants grouped according to the Position of the Tongue at Rest
(There is a significant difference at the 5 per cent level.)

	No. of Cases	*Mean mm.*	*S.E.*
Tongue between gum pads	261	+0·32	±0·103
Tongue confined to lingual vestibule	85	+1·44	±0·171

To film only the idle swallow would have involved more patience than either the operator or the child possessed, as it takes place so infrequently at this age, and they cannot be induced to swallow to order. In order to induce swallowing a stimulant was found to be necessary; for this purpose chocolate seemed the most universally acceptable.

As access to the infants was not offered when suckling, it was not possible to make consistent observations of the suckling behaviour of all subjects. It was found, however, that the infants would quite readily suck at a finger placed in the mouth. In about 15 per cent of cases the tongue failed to be protruded between the lower gum pad and the finger. This was later confirmed on a few cases when a bottle and teat were substituted. Similarly, about 23 per cent of cases were found not to protrude the tongue between the gum pads at rest. It was found necessary to make this particular observation on the infant while still asleep in the cot. Even then, only one opportunity was offered, since the immediate reaction to touch on the lips is protrusion of the tongue. Both of these conditions showed statistically significant association with an increased anterior overbite of the gum pads at birth (*Tables I* and *II*). Although it is impossible to say whether the tongue position is determined by the amount of overbite or vice versa, it is, perhaps, suggestive that the distribution of cases was much more unequal where the overbite was least. Apart from this there appeared to be no obvious variation in the suckling behaviour of infants at birth.

Whereas, at birth, it had been quite easy to approximate the gum pads, by the age of 6–8 months, when the deciduous incisors are about to erupt, considerable resistance was offered to this manœuvre. Although this would

Table II.—Mean Dimensions of Overbite at Birth of Infants grouped according to the Position of the Tongue

	No. of Cases	*Mean mm.*	*S.E.*
Tongue penetrating between gum pads	141	+0·07	±0·143
Tongue confined to lingual vestibule	37	+1·04	±0·264

appear to be protective, it was not associated necessarily with any previous painful experience, because it occurred in cases where there was an anterior space between the gum pads and the incisors had not erupted. In spite of this reluctance to bring the gum pads into contact, there was no hesitation in biting hard on a finger provided the gum pads were kept apart. It seemed that this was related to the spatial relationship of the jaws, the muscular resistance occurring only when the gum pads were within 3 mm. of contact. This mechanism did not disappear until the eruption of the upper and lower first molars.

The author has not, so far, been able to detect any obvious variations of swallowing behaviour much before the age of about 18 months. It is, perhaps, significant that at about this age the child is beginning to use the idle swallow more frequently to dispose of saliva, and the first contact between the deciduous molars occurs. Examination of the film showed quite a wide range of differences of behaviour of the lips during swallowing from this age onwards. In order to assess the significance of these differences, if there is any, it was necessary to attempt to classify them. After a large sample of the film had been examined, a provisional classification was made, dividing the sample into types. Originally six types were identified (*Fig.* 1), but most of these seemed to fall into two main groups, each comprising about a half of the sample.

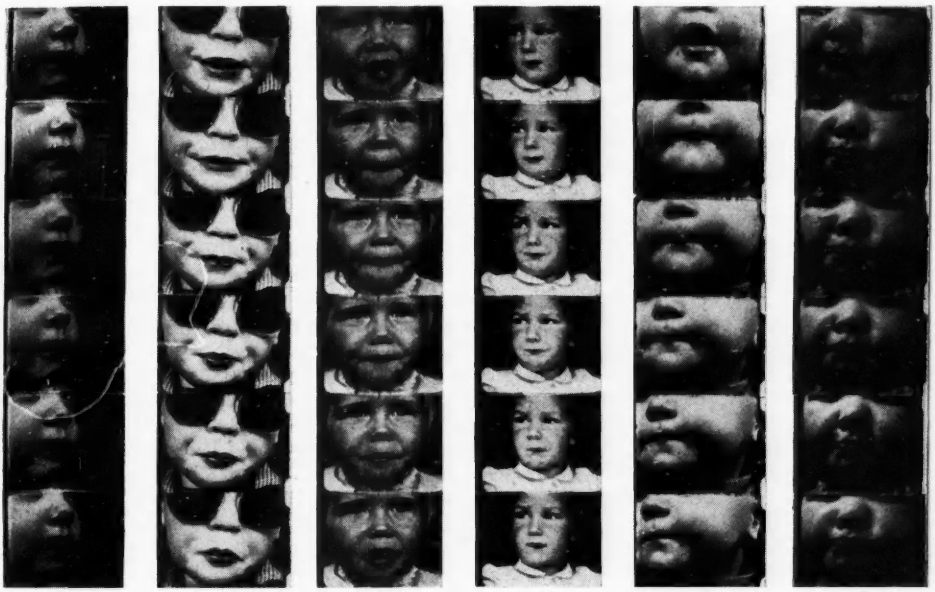

Fig. 1.—Serial extracted frames of ciné film of six types of lip behaviour during swallowing.

In the first group of cases, which will be called Group 1, the teeth were almost always together at the moment of swallowing, and the vermilion border of the lower lip was visible, there being no tendency for this to slip under that of the upper lip. There was no obvious contraction of the musculature of the lips in 4 cases, the act of swallowing being detectable only by movements in the neck over the larynx (*Fig.* 1 A). Parting of the lips showed the teeth to be in occlusion, and this was confirmed by palpating the contraction

of masseter muscle at the moment of swallowing. No evidence could be found that the tongue penetrated between the upper and lower incisors.

Some contraction of orbicularis oris muscle, as manifested by dimpling at the angles of the mouth, was seen in the remaining 126 cases (*Fig.* 1 B). These children showed no contraction of mentalis muscle. The orbicularis oris contraction lasts $\frac{1}{4}$–$\frac{3}{4}$ sec. On pulling the lips apart the teeth were occasionally found to be parted, but were usually in occlusion at the moment of swallowing, and there was never any visible evidence of the tongue penetrating between the incisors. Almost invariably some contraction of masseter muscle could be felt at the time of swallowing. Of the cases examined in the image intensifier 2 occluded the teeth together, and in 1 there was some doubt. The tip of the tongue appeared in all cases to remain lingually to the lower incisors.

In the second group of cases (Group 2) the teeth were usually apart at the moment of swallowing, and the lower lip passed under the upper at some stage of the swallow. Three types have been identified in this group. The first type, of which there were 74 cases, showed a preliminary contraction of the lower lip with dimpling under the angles of the mouth; this was followed by drawing in of the vermilion border of the lower lip under that of the upper lip (*Fig.* 1 C). After about half a second the border of the lower lip appeared to flip out from under the upper lip, and the musculature then relaxed. Although the contraction appeared to be concentrated gradually, the lower lip escaped quite rapidly. The contraction lasted $\frac{1}{2}$–$1\frac{1}{4}$ sec. There was rarely found to be any contraction of masseter muscle on palpation, and parting of the lips at the time of the swallow usually revealed the tongue lying over the tips of the lower incisors. Ciné X-ray film of 2 cases of this type showed the teeth to be together at the moment of swallowing and the tip of the tongue to be lying above the level of the lower incisors, against the upper incisors. Only 1 of these cases had shown masseteric contraction during the clinical examination.

The preliminary contraction of the lip musculature was both active and prolonged in the second type of Group 2, of which there were 33 cases (*Fig.* 1 D). The lower lip was thrust up under the upper lip, there being obvious puckering of the chin and only a moderate amount of dimpling under the angles of the mouth, that is, mentalis muscle appeared to contract strongly. The lips were difficult to part in these cases, but it seemed that the tongue penetrated between the incisors to oppose the lower lip. Contraction of the labial musculature lasted $\frac{1}{2}$–$1\frac{1}{2}$ sec. Three cases were filmed in the image intensifier; in all of them the teeth were widely apart at the time of swallowing, and the tongue bulged over the tips of the lower incisors against the lower lip. It was noticed that the mandible moved anteroposteriorly just before the swallow, but that it was retracted at the moment of swallowing. This movement may be detected clinically by viewing the patient in profile.

The activity of the circumoral musculature of the remaining 25 cases of this group was not at all marked (*Fig.* 1 E). The lower lip appeared almost to fall behind the upper lip, and there was some dimpling below the angle of the mouth. Occasionally the lips were not brought together, being separated by the upper incisors, which were exposed to view. Usually the teeth were parted at the time of swallowing. The contraction lasted $\frac{1}{4}$–$\frac{3}{4}$ sec. Of 2 cases filmed in the image intensifier, 1 placed the teeth together and the other had the teeth apart at the moment of swallowing. The former case had some masseteric contraction when examined clinically, but the tongue penetrated above the lower incisors.

A further type of swallowing behaviour was obtained in 3 cases only. Here the lower lip was thrust upwards in front of the upper lip, the vermilion border of which was covered (*Fig.* 1 F). This was achieved by strong contraction of mentalis muscle. The lip contraction lasted 1–2 sec. No masseteric contraction could be detected clinically. All 3 of these cases were of prenormal occlusion.

Although the classification of these cases was not at all easy, it was possible to place the

majority into one of these categories. Some, however, either because of failure to record an obvious swallow, or because they appeared to be intermediate between two types, had to be omitted.

It was noticed when comparing film of each individual taken at different ages that the types of behaviour remained remarkably constant. Although the degree of activity diminished, the type of activity remained unchanged up to the age of 4 years. After this age, however, some changes of behaviour were seen; most of these were from the second to the first type of Group 1. This process does not appear to be a sudden one; in most cases the patient alternated between one type and the other.

The stability of the type of behaviour up to the age of 4 would suggest that maturation does not play any part in the establishment of atypical swallowing behaviour. If this had been the case migration from one type of behaviour to another would have been expected. Certain measurements made on the models have been used to assess the relationship between morphology and behaviour:—

a. The anterior length of each arch was measured from the most prominent part of the arch along a perpendicular to a transverse

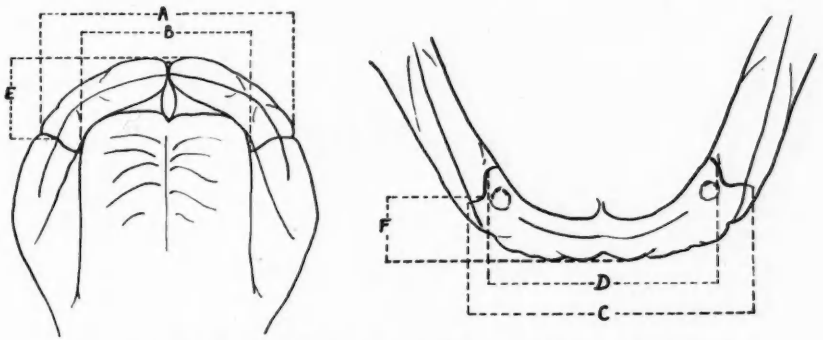

Fig. 2.—Diagram of upper and lower gum pads to illustrate sites for measurement of the anterior length of each arch (E, F).

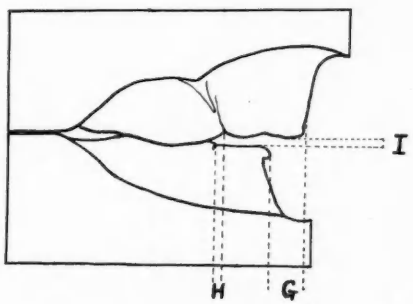

Fig. 3.—Diagram to show the sites of the measurements of the overjet (G), the anteroposterior distance between the upper and lower lateral sulci (H), and overbite (I).

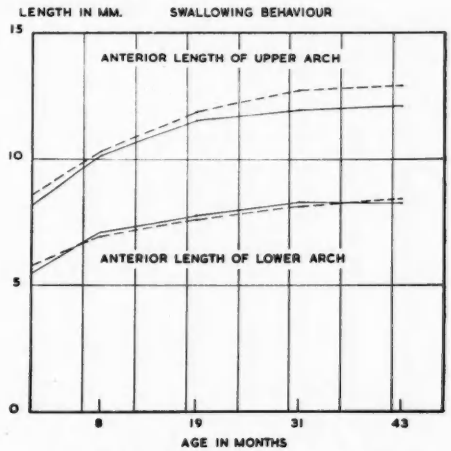

Fig. 4.—Graph to show changes of the mean anterior length of each arch with age of Group 1 (continuous line) and Group 2 (interrupted line) swallowing behaviour.

line drawn between the points where the lateral sulci cross the crest of the alveolus (*Fig.* 2).

b. The overjet was measured as the horizontal distance between the labial surface of the upper right central and the labial surface of the lower right central. In the case of the gum pads at birth, the most prominent point of each arch was used, and the measurement was made clinically (*Fig.* 3).

c. The anteroposterior distance between the upper and lower lateral sulci was measured as the horizontal distance between the buccal extensions of the lateral sulci. If the lower were distal to the upper it was registered as a negative reading (*Fig.* 3).

d. The overbite was measured as the vertical distance between the tip of the upper right central to that of the lower right central. In the case of the gum pad it was measured between the crests of the upper and lower gum pads in the mildine with the gum pads approximated. Where the point in the upper arch was above that of the lower it was recorded as a negative reading (*Fig.* 3).

As Ballard has indicated (1952), the thought has crossed the mind of at least one orthodontist that the skeletal pattern at an early age might influence the subsequent development of oromuscular behaviour. At the time that the survey was started facilities for taking lateral skull X-rays were not available. By the time they became so the subjects were between 3 and 4 years old. Lateral X-rays are available, therefore, only from this age. If, as Brodie (1941) suggests, the skeletal pattern

Table III.—Mean Dimensions of the Anterior Length of the Upper Arch, between Birth and 43 Months, of Children divided into Two Groups according to their Swallowing Behaviour
(The measurements in bold type show a Significant Difference at the 5 per cent level)

Age in Months	Group 1			Group 2		
	No. of Cases	*Mean* mm.	*S.E.*	*No. of Cases*	*Mean* mm.	*S.E.*
0	92	8·22	±0·082	91	8·41	±0·093
8	122	10·15	±0·084	122	10·17	±0·081
19	116	11·57	±0·110	119	11·85	±0·126
31	113	**11·99**	±0·109	103	**12·72**	±0·119
43	99	**12·05**	±0·114	83	**12·87**	±0·150
0–43	93	**+3·73**	±0·150	56	**+4·52**	±0·184

Table IV.—Mean Dimensions of the Anterior Length of the Lower Arch, between Birth and 43 Months, of Children divided into Two Groups, according to their Swallowing Behaviour

Age in Months	Group 1			Group 2		
	No. of Cases	*Mean* mm.	*S.E.*	*No. of Cases*	*Mean* mm.	*S.E.*
0	92	5·55	±0·090	91	5·76	±0·092
8	122	6·98	±0·082	122	6·91	±0·084
19	116	7·68	±0·089	119	7·61	±0·080
31	113	8·23	±0·079	103	8·16	±0·092
43	99	8·25	±0·086	84	8·27	±0·111
0–43	73	+2·64	±0·124	57	+2·40	±0·168

remains fairly constant after the age of 6 months, then it may be permissible to use the skeletal relationship calculated at a later age as an indication of the earlier relationship. To assess this the difference between the angles S N A and S N B has been used. This is not entirely satisfactory as a method of estimation, as A and B points lie over the developing permanent incisors at this age. However, it is probably the method least subject to error.

Table V.—Mean Dimensions of the Overjet, between Birth and 43 Months, of Children divided into Two Groups according to their Swallowing Behaviour
(The measurements in bold type show a Significant Difference at the 5 per cent level)

Age in Months	Group 1			Group 2		
	No. of Cases	*Mean* mm.	*S.E.*	*No. of Cases*	*Mean* mm.	*S.E.*
0	122	5·14	±0·135	121	5·44	±0·127
8	122	3·74	±0·176	122	4·12	±0·173
19	116	**3·46**	±0·145	119	**4·25**	±0·139
31	114	**3·04**	±0·132	103	**4·34**	±0·171
43	99	**2·72**	±0·137	83	**4·28**	±0·229
0–43	73	**−2·74**	±0·192	56	**−1·48**	±0·287

Table VI.—Mean Dimensions of the Anteroposterior Distance between the Upper and Lower Lateral Sulci, between Birth and 43 Months, of Children divided into Two Groups according to their Swallowing Behaviour
(The measurements in bold type show a Significant Difference at the 5 per cent level)

Age in Months	Group 1			Group 2		
	No. of Cases	*Mean* mm.	*S.E.*	*No. of Cases*	*Mean* mm.	*S.E.*
0	95	−1·59	±0·158	93	−1·87	±0·135
8	122	+0·11	±0·153	119	−0·31	±0·147
19	117	+1·77	±0·121	117	+1·35	±0·125
31	112	**+2·29**	±0·124	102	**+1·72**	±0·143
43	100	**+2·61**	±0·122	85	**+1·76**	±0·179
0–43	73	+4·27	±0·197	57	+3·84	±0·270

Table VII.—Mean Dimensions of the Overbite, between Birth and 43 Months, of Children divided into Two Groups according to their Swallowing Behaviour

Age in Months	Group 1			Group 2		
	No. of Cases	*Mean* mm.	*S.E.*	*No. of Cases*	*Mean* mm.	*S.E.*
0	122	+0·57	±0·154	121	+0·75	±0·165
8	122	−0·25	±0·143	122	−0·08	±0·145
19	116	+2·40	±0·127	119	+2·46	±0·117
31	114	+2·55	±0·153	103	+2·25	±0·170
43	99	+2·30	±0·158	83	+2·01	±0·215
0–43	73	+2·04	±0·225	56	+1·43	±0·328

Comparison of the mean anterior length of the upper arch showed great similarity between the two groups up to the age of 19 months, after which that of Group 2 tended to increase more rapidly. The difference between the two became statistically significant from 31 months (*see Fig.* 4 and *Table III*).

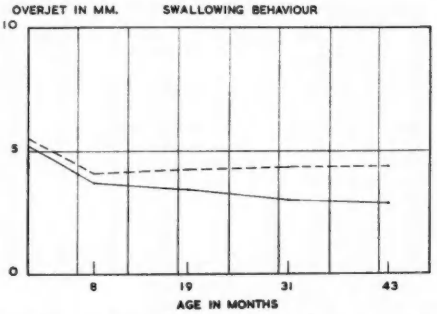

Fig. 5.—Graph to show changes of mean overjet with age of Group 1 (continuous line) and Group 2 (interrupted line) swallowing behaviour.

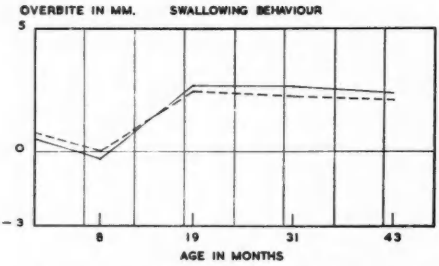

Fig. 7.—Graph to show changes of mean overbite with age of Group 1 (continuous line) and Group 2 (interrupted line) swallowing behaviour.

The corresponding dimension of the lower arch remained the same in both groups (*Table IV*).

The mean overjet was found to be greater for Group 2, the difference increasing steadily from the age of 8 months, and becoming statistically significant from the age of 19 months (*see Fig.* 5 and *Table V*). Although there was a difference up to 8 months, it was not significant statistically. The wide range of overjet seen at birth (2–9 mm. for Group 1, and 2–8 mm. for Group 2) would suggest that this is not an important factor in determining oro-muscular behaviour.

A similar picture was reflected in comparison of the anteroposterior distance between the lateral sulci, which was less for Group 2, the

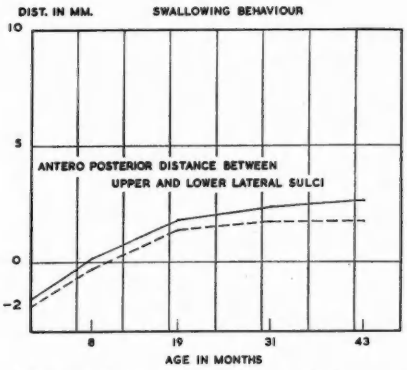

Fig. 6.—Graph to show changes of the mean anteroposterior distance between the upper and lower lateral sulci of Group 1 (continuous line) and Group 2 (interrupted line) swallowing behaviour.

difference increasing steadily with age. This was only significant from the age of 31 months (*see Fig.* 6 and *Table VI*).

The mean overbite was similar in both groups, however, being slightly more at birth but less after 19 months for Group 2 (*see Fig.* 7 and *Table VII*).

Division of a sample into those with and those without masseteric contraction at the moment of swallowing showed similar dimensional differences. The anterior length of the upper arch, overjet, and anteroposterior distance between the upper and lower lateral sulci

Table VIII.—Percentage Incidences of Cases with no Sucking Habit and with a Persistent Sucking Habit among Two Groups classified according to the Type of Swallowing Behaviour
(Cases where Sucking Habits have ceased are omitted. Both differences are significant at the 5 per cent level.)

	Swallowing Behaviour		*S.E. of Difference*
	Group 1	Group 2	
Number of cases	119	119	
Percentage with no sucking habit	43·7	15·1	±5·9
Percentage with persistent sucking habit	24·4	52·1	±6·3

showed only slight differences at birth, which increased with age. There was again no statistically significant difference of overbite between the two groups.

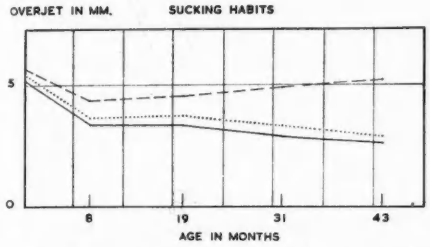

Fig. 8.—Graph to show changes of mean overjet with age of children classified according to the presence of sucking habits. Continuous line represents children with no sucking habit at all, dotted line children who have ceased such a habit, and the interrupted line children with a persistent sucking habit.

oromuscular behaviour. It has already been shown that there was a significant difference of overjet between the two groups of swallowing behaviour by the age of 19 months. Rix, in a letter to the *Medical Press* in April, 1959, wrote: "I have an unconfirmed impression that sucking habits are rather more common among those with underlying conditions which do not foster a close approximation of the upper and lower incisor teeth." Analysis of the incidence of sucking habits among the two groups of swallowing behaviour confirmed Rix's belief that these two conditions are likely to occur together (*Table VIII*).

A glance at *Table IX* and *Fig.* 8 will confirm that where persistent sucking habits occur, there is in fact as early as 8 months a significantly larger mean overjet, the difference increasing with age. There is nothing, therefore, in these statistics to indicate that a sucking habit may not at times be the forerunner of certain types of oromuscular behaviour.

Table IX.—MEAN DIMENSIONS OF THE OVERJET OF CHILDREN WITH AND WITHOUT SUCKING HABITS BETWEEN BIRTH AND 43 MONTHS
(The measurements in bold type show a Significant Difference at the 5 per cent level)

Age in Months	Habit Still Active			Habit Ceased			No Habit		
	No. of Cases	*Mean* mm.	*S.E.*	*No. of Cases*	*Mean* mm.	*S.E.*	*No. of Cases*	*Mean* mm.	*S.E.*
0	91	5·58	±0·157	109	5·32	±0·143	82	5·16	±0·138
8	91	**4·30**	±0·211	110	3·54	±0·182	83	**3·37**	±0·222
19	92	**4·49**	±0·155	106	**3·64**	±0·173	79	**3·30**	±0·163
31	67	**4·93**	±0·208	91	**3·22**	±0·125	65	**2·81**	±0·165
43	54	**5·06**	±0·272	81	**2·80**	±0·163	52	**2·60**	±0·182
0–43	38	**−1·05**	±0·355	54	**−2·20**	±0·220	38	**−2·90**	±0·248

Although no significant differences of dimension were found between the two groups of swallowing behaviour at birth, there still remains the possibility, as Nord has suggested (1959), that some other agency may have been responsible for a dispersal of the incisors, which in turn induces a particular type of

Table X.—MEAN MEASUREMENTS OF THE DIFFERENCE BETWEEN THE ANGLES S N A AND S N B OF TWO GROUPS OF CHILDREN DIVIDED ACCORDING TO THEIR SWALLOWING BEHAVIOUR

Type of Swallowing Behaviour	*No. of Cases*	*Mean Difference S N A–S N B*	*S.E.*
Group 1	64	4·09°	±0·227°
Group 2	60	5·13°	±0·250°

This cannot, however, be put forward to explain the origin of the majority of Group 2 types of swallowing behaviour, because the

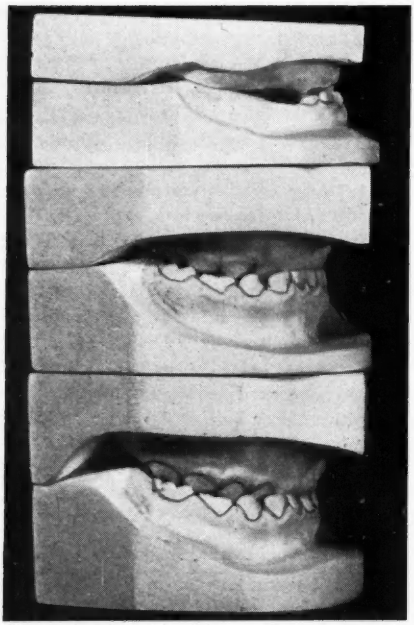

Fig. 9.—Serial models of the case shown in *Fig.* 1 F.

distribution of overjets is so similar in the two groups.

The occurrence of 3 prenormal cases with a type of swallowing behaviour peculiar to themselves suggests that there is a relationship between prenormality and this type of behaviour. Because these cases formed only a minority of prenormal cases, of which most belonged to Group 1 swallowing behaviour, it cannot be claimed that the incisor relationship alone is responsible for the behaviour. However, although no X-ray evidence is available the author had the impression that all these cases were skeletally more prenormal than the others. This is suggested by the models (*Fig.* 9) of the last case shown in *Fig.* 1. Of the remaining 7 prenormal cases, which belonged to Group 1, 3 improved spontaneously (*Fig.* 10), and were, therefore, probably only mildly prenormal.

The mean differences between the angles S N A and S N B are shown in *Table X*. Although the means for Group 1 and Group 2 differ by only 1° this is just statistically significant at the 5 per cent level of probability.

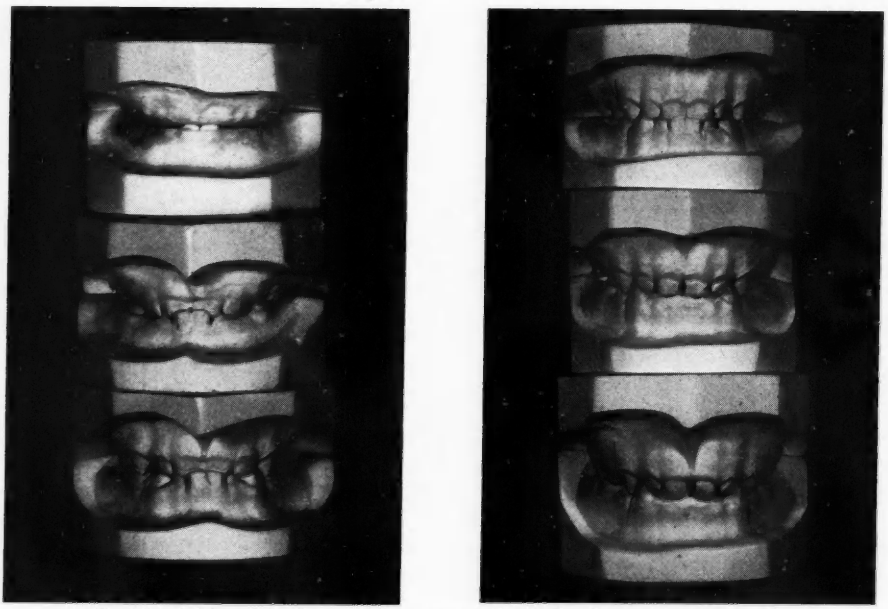

Fig. 10.—Serial models of a case where prenormal occlusion improved spontaneously.

This association, albeit not a strong one, does suggest that skeletal morphology may sometimes influence oromuscular behaviour. However, this cannot be put forward as being of great significance, since the distribution of individual measurements was not dissimilar in the two groups.

By and large, therefore, this analysis points to the conclusion that behaviour of the orofacial musculature is usually determined independently of skeletal morphology, tending to precede rather than to follow those changes that later become associated with it.

SUMMARY

An attempt has been made to identify differences of oromuscular behaviour at an early age by following a sample of children from birth. The difficulties of achieving this have been discussed. It would appear that the most satisfactory method of assessment would be based on an analysis of ciné X-ray film. However, economic difficulties and the hazards of radiation have prevented this approach on a sufficient scale so far to obtain conclusive information. Using ordinary ciné film, some variations of lip activity during swallowing have been shown to exist from the age of 1½ years. A provisional grouping of some of these types has been used as a basis for a statistical analysis of certain dimensions. The stability of types of behaviour between 1½ and 4 years of age suggests that differences of maturation rate do not account for the appearance later of "infantile" swallowing pattern. The similarity of both means and ranges of dimensions of relationship at birth between the groups lends support to the thesis put forward by Ballard that patterns of oromuscular behaviour are probably endogenous, arising independently of skeletal morphology in most cases.

Acknowledgements.—A work of this type cannot be undertaken without a considerable amount of help from others. The author owes his first debt of gratitude to Mr. J. H. Peel, Director of the Department of Gynæcology and Obstetrics at King's College Hospital, and his staff, who went to so much trouble to provide access to the babies at birth. Thanks are due to Professor R. Cocker and Professor K. P. Liddelow for much help and encouragement with the preparation of the ciné film. To Dr. I. MacLaren, Director of the X-ray Department at St. Thomas's Hospital, the author owes a great debt for providing access to the image intensifier and help in taking the films. The author bears a special debt of gratitude to Mr. D. J. Britten, who undertook most of the statistical analysis. To Mr. W. J. Tulley the author will always be grateful for reading the proofs of this paper and for offering much helpful advice. Finally, without the loyal co-operation of the parents of these children, who have been brought through all weathers for examination, the survey would have petered out; to them and their children is owed the greatest debt of all.

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DISCUSSION

The President thanked Mr. Leighton for his most interesting paper. It had been a feat of co-ordination in the method of presentation with the slides, as well as the films. All knew what an enormous problem was posed from the beginning for anyone engaged in longitudinal studies, and the author was to be congratulated on his courage in attempting such an enormous task. He invited Mr. Rix to open the discussion.

Mr. Rix said they had listened to a paper involving a great deal of patient work in a relatively neglected period of life, and the three questions which Mr. Leighton had posed for himself were important. First, was the mode

of swallowing secondary to morphology? Secondly, were variations in the mode of swallowing merely maturation delays? Thirdly, were they inherent, genetically determined, and independent of time and morphology?

Although he had been asked to open the discussion, he had not many bones to pick with the author, but there were one or two points which he would make. The author had said that gum pads were difficult to approximate by 6–8 months. A finger would be gripped yet a resistance to further closure would be put up within 3 mm. of contact of the gums. He had said that this mechanism did not disappear until the eruption of the first deciduous molars. Would Mr. Leighton be prepared to accept an alteration in phraseology here which would better interpret the mechanism? Would it not be feasible to say that the mechanism did not in fact disappear but that the occlusal rise of the first deciduous molars continued until this resistance dimension was obliterated?

The swallowing behaviour did not show obvious variation before 18 months. Thereafter the youngsters were put into two main groups, and it so happened that the groups were about equal in numbers. Half showed no activity or a little activity of the lips, and the teeth were almost invariably in occlusion. In the other half there was more lip activity and the teeth were usually apart, with the tongue lying over the tips of the lower incisors.

In this second group three types of behaviour were distinguished. In the first group there were two types. He would have been happier if these five types had not been lumped into two groups. There was perhaps a temptation to form groups which were large enough to reduce the inquiry to a statistical exercise, but more would have been learned in the end if the types had been kept very exclusive and discrete. He hoped that Mr. Leighton would give them another paper in ten years' time on a longitudinal study of these various types. If, however, they accepted his two main groups as broadly representing swallowing behaviour—and he thought they could—the co-relations which the author had found were most interesting.

He noted that the digit suckers were more numerous in Group 2. There was just over a 50 per cent chance of a habit being present if a child were a Group 2 swallower. One could not argue that the Group 2 swallowing behaviour was a result of the sucking habit, and the whole analysis pointed to the conclusion that behaviour was usually determined independently of skeletal morphology. There was also the point that there was a certain stability of behaviour and that maturation in the period investigated had brought to light very little fundamental change. Occasionally in later years, in the later 'teens, he had seen changes of a fundamental character, the last being a Class II, division 2 which had been treated; here the teeth had not originally been together when swallowing, but finally they had been together. In treated postural Class III cases he would have thought that a similar change might sometimes be seen.

They had seen an interesting shifting of the mandible in the image intensifier X-ray shown by the author, but he wondered whether this was related to swallowing. If you had chocolate glued to the roof of your mouth you would try to remove it by anteroposterior movements of the tongue, and these would tend to rock the mandible backwards and forwards. One must be very careful before ascribing these movements to preliminary swallowing movements.

He congratulated Mr. Leighton on his tenacity over the years in seeking answers to most important questions and on throwing more light on those early years which had remained in the shade for so long.

Mr. Tulley also congratulated Mr. Leighton on his work. He had seen some of the effort which had gone into the paper. The attempt to use ciné X-ray films was worthy of special commendation.

He had no questions to ask, because he had already asked them privately. He had found that in looking at the films for the first time it was difficult to distinguish the detail of the swallowing behaviour. One always found in filming children that a great deal of idle lip activity went on all the time. Those members who had just seen the films for the first time could not distinguish these details as easily as could Mr. Leighton, who had lived with the films and could see much more in them.

The value of the work would be seen when the children began to change their dentition and when one could see the environment affecting the erupting incisors. He hoped that Mr. Leighton would continue the work with the same vigour and would not lose too many of his patients—because that was the difficulty with long periods of study.

Professor Ballard congratulated the author on his painstaking work. There was not much one could say about the investigation except to wish him luck in not losing more of the children before they reached the stage when their permanent dentition had erupted. He hoped that even then Mr. Leighton would not be disappointed if he found that the majority of them had normal occlusion! Statistics suggested that they would.

Although they thought that soft-tissue behaviour was developed independently of the skeletal morphology, it had to be adaptive, and it was because it was adapted that with extreme variations of morphology normal occlusions could occur.

From the point of view of clinical experience, however, it is important to realize that it is only endogenously adaptive. Permanent adaptations could not be induced by exercising or conscious effort.

Mr. Gwynne-Evans said he was grateful to Mr. Tulley for asking him to join the meeting. With Professor Ballard and Mr. Tulley, he had spent many years working on these problems. It had given him pleasure to hear Mr. Leighfon's paper and his review of past work. It was important that we should understand more about how much behaviour was innate and how much was adapted or acquired through environmental contacts, because a dogma was emerging from work in other fields, viz., that nothing short of a genetic process could alter a genetic pattern whatever that pattern may be. He congratulated Mr. Leighton on his address.

Miss Clinch also congratulated Mr. Leighton. She realized the amount of work which had gone into the paper, but it was a consolation to feel that oromuscular behaviour was not as important as they had recently been led to believe. Obviously the majority of these children would have a normal occlusion. They were an unselected group, and it would still be found that there was more good occlusion than malocclusion in an unselected group.

Had Mr. Leighton any evidence about the position of the tongue? She knew that the tongue was between the pads at rest. It was her impression that there were some cases in which the tongue remained between the teeth at rest. Had Mr. Leighton noticed that in any of these children?

It was always difficult to know clinically whether the teeth were together when swallowing occurred, and she was consoled to learn that the author had also found this difficult. It was simple to write, "Teeth together at swallowing", or "Teeth apart at swallowing", and it was very tempting to do this, but she doubted whether it was always accurate.

Did Mr. Leighton think that there was a fixed position at which the upper and lower gum pads occluded or met, rather than a condition similar to that of an edentulous adult?

Mr. Wilson endorsed all that had been said about Mr. Leighton's work. Some of those speaking in the discussion, however, had been speaking of morphology when they meant behaviour, which the author had been studying; morphology was something entirely different and might be studied in a continuation of his work. Morphology of the tongue was probably more important in some of these cases than morphology of the lip muscles.

The author's graphs had given a clear picture, but would they not have given a more accurate picture in the form of scattergrams? These would have demonstrated that the types were not as far apart in some cases as might be believed from the graphs and that one group would evolve into the other.

Illustrations often tended to remain in the memory longer than the spoken word. This overlap which occurred would therefore have been better illustrated by the use of scattergrams.

Mr. Leighton, in reply, said that he had expected to be pulled to pieces in the discussion. He thanked Mr. Rix for his kind remarks. He gathered that when Mr. Rix said that the first molars moved up into the space as they erupted between the gum pads, he implied that the occlusal level rose. He could offer no opinion on that; his feeling was that the children were willing to bite on teeth or on an object but were not willing to bite their two gum pads together. It might be because it overclosed the mandible or it might be that a defence mechanism prevented them from biting themselves.

In drawing attention to the division of these types into two large groups Mr. Rix had put his finger on the one weakness of this classification. It had been necessary to have reasonable numbers for a statistical analysis. The division of the sample into the six original types would have left the types with so few numbers that nothing could be learned from them. The division into groups had been merely a working hypothesis and had not been intended as final. It might be revised as the children grew, but it had been necessary to start with a simple classification in order to study the children statistically.

Mr. Rix had mentioned that some children might change their behaviour later in life. The cases which he had mentioned, however, had been treated cases, not untreated. A change of behaviour without being stimulated by a change of environment probably did not occur.

The rocking of the mandible shown on the X-ray had been a preliminary peculiar to cases in the second group, and they had practically all been in that second type in the second group. It had not been seen in any other cases, even before they swallowed.

He agreed with Mr. Tulley that the types were difficult to distinguish, and when playing a film straight through he himself had had great difficulty in determining the different types. The only satisfactory way was to put the film into an "editor" by which it could be run backwards and forwards as often as necessary and studied frame by frame.

Professor Ballard had expressed the belief that most of these cases would become normal. He sincerely hoped that this was right and he would not be in the least disappointed if it were; because if it were not, there was a threat that all these cases would descend on him for treatment! If he had to treat them all, it would completely ruin his research.

He had no doubt that behaviour was adaptable to morphology, but his general impression was that morphology was not the controlling factor in determining behaviour. Behaviour was developed independently of morphology and morphology was perhaps thrust upon it.

He took issue with Mr. Gwynne-Evans in the suggestion that these behaviour patterns were genetic; he had not said that at all. He had said that they were developed independently of morphology, or so it appeared. To decide that they were genetic required an altogether different study. It must be based on a study of parents of children or twins.

Miss Clinch had asked whether the tongue was between the teeth in any of the cases. He could not say whether this was so. It was difficult in young children to move the lips without disturbing everything. Immediately you approached a child with the hand, the mouth opened, because they found that the children were so well trained, and you could see nothing but teeth. It was very difficult to study children in their rest position. The only solution was to take X-ray pictures without touching them. The gum pads at rest could be placed in the same relationship repeatedly; it did not seem to vary provided that you did not exert any pressure backwards or to one side. It was possible by varying the direction of pressure, especially if it were excessive, to produce almost any sort of relationship you chose. Provided that you used gentle pressure upwards and had them completely relaxed, it was possible to repeat the same relationship time and time again. It did not seem to vary. At that age the mandible was rather mobile and rather soft, and it was possible to bend all the tissues if you used excessive force.

Mr. Wilson had asked about the morphology of the tongue. The author had made no attempt to study either the morphology or the position of the tongue at rest. The lateral X-rays were available, and the information was available, as far as it could be obtained from lateral X-rays.

He must justify his use of graphs. These were supported by statistics, but he had spared the audience these. He had been advised that orthodontists did not like figures! If a statistical analysis were made of these figures and standard errors were calculated for each of the means, it was possible to indicate the amount of variation above and below each mean. By doubling the standard errors and taking the sum of two adjacent ones it was possible to determine whether the difference was statistically significant. This was what he had done. Scattergraphs or scattergrams showed quite well what he wanted to explain, but they could not be subjected to mathematical analysis and it was impossible to say whether what was seen on the graph was the result of chance or was a real difference.

He thanked those who had contributed to the discussion for having been so kind.

The President said there had been some hesitation to take part in the discussion at the beginning, not because people were not interested—they were very interested—

but because this was a problem of many facets on which they required time to reflect. They would look forward to seeing the paper in print. The author had made a courageous attempt and they hoped that he would continue his work. If Mr. Tulley were still Editor in 1969, no doubt he would arrange for Mr. Leighton to give another paper about his conclusions on these children, still munching their chocolate to the age of 14—if their teeth had not disappeared through caries by then!

He hoped that the author's studies would not go the melancholy way of so many statistical studies and that by then he would find he had only 2 cases left, one being normal and the other abnormal!

He was sure that the audience would join with him in proposing a hearty vote of thanks to Mr. Leighton for all the time and trouble he had given to the careful presentation of such an interesting paper.

The vote of thanks was carried with acclamation.

Recurring Mandibular Supplemental Bicuspids

A girl, aged 11 years in 1944, was referred for extraction for orthodontic reasons. Eight impacted, supplemental bicuspids were seen and removed during a span of 8 years. From the left side of the mandible the first bicuspids and two impacted supplemental bicuspids were removed. From the right side the first bicuspid and one impacted supplemental bicuspid were removed. Both areas were radiographed to show complete removal. Films taken 5 years later showed two additional impacted, supplemental bicuspids on the left side and one such tooth on the right side of the mandible. The teeth were removed and the areas radiographed. In 1949 a film of the left maxilla showed two impacted, supplemental bicuspids which were not present in 1944. It is stated that 75 per cent of supplemental bicuspids are impacted and generally unerupted and their incidence is about 1 in 10,000 people. A characteristic of these impacted teeth is a marked tendency to the formation of cysts.—MORGAN, G. A., POYTON, G. H., and CROUCH, S. A. (1959), *J. Canad. dent. Ass.*, **25**, 763.

Auditory Analgesia in Dental Operations

An attempt was made to eliminate the patient's awareness of the noise of the drill by masking it with another noise. It was hoped in this way to avoid the anxiety and tension which accompanies many operative procedures. A random noise similar to the roar of Niagara Falls was generated and fed to the patients by earphones, and the volume of this noise was left in the control of the patient. Preliminary tests showed that without any other form of analgesia or anæsthesia the anxiety associated with cavity preparation was reduced and furthermore the pain was suppressed. This suggested that a true analgesic effect was produced.

The technique was developed. Music as an alternative was tried, and by experimenting with various frequencies in the "sound spectrum" a balance was achieved that was both pleasant to listen to and also analgesic. The operator also wore earphones and thus was able to judge the subjective sensations of the patient by the changes he made to the volume of the music.

The Audio Analgesiac was used on over 600 patients during various cavity preparations, scalings, and grinding operations. This produced completely effective analgesia in 63 per cent. In 25 per cent some discomfort was felt but no anæsthetic was required. The technique was not helpful to the remaining 12 per cent.

To add emphasis to the effectiveness of the technique it is stated that in one year the number of local anæsthetic ampoules used in practice was reduced from 2000 to 118.

Extractions were also attempted and at the time of writing 136 teeth had been removed with Audio Analgesiac as the sole agent.

Several factors are suggested as contributory to the analgesic effect. A genuine suppression of pain by sound. Distraction of the patient's mind from dental worries. The feeling by the patient that he has control over things that are happening to him. The communication of the patient with the operator via the volume control. Finally an element of suggestion.

The technique has been employed by five other practitioners and found to be effective in 90 per cent of their patients.—GARDNER, W. J., and LICKLIDER, J. C. R. (1959), *J. Amer. dent. Ass.*, **59**, 1145.